PORT QUENDALL

INVESTIGATION

878602

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1.0
INTRODUCTION

This report identifies the types of chemical residues present in the soils and groundwater of the Port Quendall property, describes the hydrogeologic setting of the site, and provides a preliminary characterization of the magnitude and distribution of potential contamination on the property. The purpose of the report is to provide information for the preparation of remedial actions that are necessary and consistent with the development plans for the property.

The Port Quendall property is located on the southeastern shore of Lake Washington, west of the 44th Street overpass to Highway 405, and north of the commercial center of the City of Renton (Figure 1). Port Quendall is jointly owned by Puget Timber Inc. and Altino Property Inc. At the present time, the property is leased to Seaboard Lumber Company for log storage.

Studies conducted for the evaluation of the property can be divided into the following elements:

- A review of geological, hydrological, and other available data pertinent to the property, including interviews with individuals knowledgeable on previous hydrogeologic studies of the area and past industrial activities conducted on the site.

- Drilling, soil sampling, and installation of monitoring wells.

- Excavation, logging, and sampling of trenches.

- Hydrologic testing and sampling of water monitoring wells.

- Laboratory analysis of water and soil samples.

This report is organized into the following sections:

1.0 INTRODUCTION

2.0 METHODS: Description of the methods used in conducting the studies outlined above.

3.0 GEOLOGY: Description of the geologic setting of the Port Quendall property

4.0 HYDROLOGY: Description of the groundwater hydrology of the property

5.0 CHEMICAL RESIDUES: Identification of the types of chemical residues in the soils and groundwater on the property and preliminary evaluation of the quantities and distribution of these residues.

6.0 REFERENCES

Appendix A: Field Boring Logs

Appendix B: Field Water Sampling Data Sheets and Water Level Data Sheet

Appendix C: Transmissibility Calculations for Selected Wells

Appendix D: Analytical Methods and Results

2.0
METHODS

DATA REVIEW

Prior to initiating field investigations, publications and other data relevant to an understanding of the hydrogeologic conditions on the property were reviewed. Primary sources of information included the library of the Washington State Department of Natural Resources, the University of Washington Library, and CH_2M-Hill Company. A listing of publications relevant to this study is provided in Section 6.0.

In addition to the literature review, aerial photographs of the project area taken in 1936, 1941, 1946, and 1960 were examined. These photographs made it possible to locate former stream channels, building sites, sumps, and other features of the property that could represent sites of potential contamination.

Meetings with the current owners of Port Quendall provided insight to earlier investigations conducted on the property and the nature of the industrial activities that occurred there. Mr. Ward Roberts, a former plant operations manager at the Reilly Tar and Chemical facility that used to occupy the property, furnished an interview and site tour. Mr. Roberts roughly mapped out the industrial facilities present on the property during his period of employment there, and described the nature of the chemical processing and landfill operations that took place at that time. Mr. Neil Twelker of Neil Twelker and Associates, Seattle, Washington, was interviewed with regard to his earlier geologic investigations of the property. He provided a location map of borings and cross sections done by his firm in January 1971.

BORING AND SOIL SAMPLING

Data from the literature review, aerial photographs, and interviews were used to develop a base map of the likely areas of contamination on the property. These areas included the sites of chemical process buildings, tanks, and sumps; landfills containing industrial waste; and an earlier, filled-in channel of May Creek (Figure 2).

The base map was used to plan the soil and groundwater field investigations of the property. Soil borings, water monitoring wells, and trenches were located to verify likely areas of high contamination, as well as areas that contained minimal levels or no hazardous materials.

A total of 18 borings were drilled to an average depth of approximately 10 to 20 feet below the ground surface (Figure 2). The borings were limited to a maximum depth of about 20 feet in order to prevent possible transfer of contamination to or from deeper horizons when some of the borings were converted to water wells.

The borings were completed with a truck-mounted B-61 drill equipped with both 4- and 6-inch inside diameter (I.D.) hollow stem augers. If the boring was designated solely for soil sampling, or sampling and the installation of a 2-inch diameter well, the 4-inch I.D. auger was used for drilling. The 6-inch I.D. auger was used when a 4-inch diameter well was designated for installation after completion of the boring.

The soil sampling program was designed to obtain the maximum information on contamination in the upper 10 feet of the ground. As conditions permitted, samples were collected continuously in each boring to an average depth of 10 feet. Below that depth, the sampling interval was increased to an average of 4 to 5 feet to the bottom of the hole.

Two types of soil samplers were on hand throughout the program: an 18-inch long, 1-3/8-inch I.D. split spoon (ASTM D-1586) and a 3-foot long, 2.8-inch I.D. Shelby tube sampler. Successful recovery is accomplished with the split spoon sampler in granular or mixed soils, while the Shelby tube sampler is more effective in clay or clayey soils. Since good recovery was achieved with the split spoon, it was used throughout the program.

To collect the soil samples, the auger drill was advanced to the desired depth and the sampler was lowered through the center of the hollow stem with connecting rods. The connecting rod/sampler assembly was then driven into the soil with a 140 pound hammer. A record was kept of the number of blows required to drive the sampler.

After being driven into the soil, the sampler was removed, opened, and the soil sample was transferred to sterilized glass jars with teflon lids. These containers were supplied by Laucks Laboratories of Seattle, Washington. As the jars were filled and sealed, they were placed in ice chests at the site. The samples were taken in the chests to the laboratory on a daily basis to minimize excessive dissipation of volatiles prior to laboratory analysis. Each jar was labeled clearly with the boring number, sample number, and name of the attending geologist. In addition, sample depths and identification numbers were recorded on the field log for each boring. To establish the chain of custody, the samples were logged in at the laboratory as they were delivered.

Following removal of the sample, the split spoon was subjected to a three phase cleaning before reassembly to avoid contamination between samples. All components of the sampler were washed and scrubbed in soap and water. This was followed by a rinse with methyl alcohol and a final wash with triple distilled, deionized water. As a check on the thoroughness of the cleaning procedure, control samples of distilled water run across the cleaned surfaces of the sampler, as well as the distilled water itself, were periodically taken to the laboratory for analysis. These samples were identified as the "W" series.

To prevent the possibility of transfer of contamination from one boring to another, augers and peripheral equipment were steam cleaned and scrubbed between borings. In addition, casings for each well were steam cleaned prior to installation. As a further precaution against contamination, all auger cuttings were shoveled into good quality reconditioned barrels and stored at each boring location. Lids were fixed on the barrels and the source boring for each barrel was marked in heavy felt pen for easy identification in future handling.

During drilling, a field log of each boring was taken by the onsite geologist. A rock/soil description, Unified Soil Classification System field designation, color, texture, moisture, sample number and depth, and standard penetration test (SPT) blow counts were recorded on the logs with depth. These logs are provided in Appendix A. A lithologic sketch log appears in one column using appropriate symbols for sand, clay, and other materials encountered during drilling. Another column was used on the log of each boring converted to a well to denote design placement of slotted screen and blank sections of casing. In borings used only for well installation, the log records only the design of the well.

WELL INSTALLATION, TESTING, AND SAMPLING

A total of 12 water monitoring wells were installed in borings on the Port Quendall property. These wells were designed to sample groundwater, provide a stationary, surveyed reference for measurement of static water levels, and provide data on aquifer performance.

Stainless steel screen and riser pipes were used in one well and the others were completed with threaded PVC screen and blank sections. Three of the wells were 2-inch I.D., while the remainder were 4-inch I.D. At selected locations, multiple wells were installed so that separate intervals could be monitored independently. Well coordinates, ground elevations, and measuring point elevations for the top of each well casing were surveyed in by a registered surveyor. A summary of the physical specifications for each well including total depth, ground elevation, measuring point elevation, diameter, material for casing and screen, and coordinate location is provided in Table 1.

Each well was installed immediately following auger boring and soil sampling. After the auger drill was advanced to the desired depth, the well casing, including bottom cap, was lowered through the center of the auger and allowed to rest on the bottom of the hole. A sand-gravel pack was poured through the auger as it was removed from the hole to assure a good continuous pack around the annulus of the well screen or slotted section. This sanding process was discontinued one to two feet above the screened section and bentonite pellets followed by a bentonite-cement slurry was then placed in the annulus to provide a seal as a precaution against intercommunication between the surface and screened zones. Finally, a cement cap approximately one foot thick was poured flush with the ground to stabilize the well head. "As built" diagrams for the wells are provided on the log sheets in Appendix A.

Where PVC was used for casing material, threaded slotted and blank sections were used with no glue or adhesives of any kind as a precaution against this source of possible sample contamination. As previously mentioned, both stainless steel and PVC casing sections were thoroughly steam cleaned prior to installation.

Following completion, each well was jetted with air using a PVC pipe set in the casing and a trailer-mounted compressor unit. The jetting was performed to assure satisfactory initial flushing of the sand-gravel pack and to improve the flow of groundwater into the well. Each well was then pumped with an electric pump to remove an equivalent of three well volumes of water. This was done to assure that samples obtained from the wells were representative of ambient groundwater conditions. If the well was incapable of delivering a satisfactory volume of water to the pump, hand bailing was employed to condition the well.

To prevent possible contamination, pump discharge was diverted directly into clean 50 gallon, closed-top drums. Each drum was labeled with the borehole number for ease of future identification and handling.

A detailed record of performance was maintained during the pumping and subsequent recovery period for each well. Prior to pumping, the static water level was measured and referenced to the surveyed measuring point on the top of the casing. The time and depth to water was noted during pumping and during the recovery period after pumping was stopped.

All static water level measurements were made with a steel tape accurate to 1/100 foot; recovery data was obtained using an electrical meter sounding device with a tested repeat accuracy equivalent to the steel tape. The use of the electric sounder was necessary because of the rapid changes in water levels observed during the recovery period.

Frequent water samples were taken during the pumping period and tested in the field to determine temperature, pH, and specific conductivity of the water. These measurements were taken with a thermometer, pH meter, and a conductivity-resistivity bridge. A summary of all information obtained during sampling is provided in Appendices B and C.

Following the pump and recovery testing, a sterilized teflon bailer of suitable diameter was used to bail an additional well volume from each well prior to sampling. Water samples were carefully poured into preconditioned, labeled containers furnished by Laucks Laboratories, Inc. These samples were stored in an ice chest onsite until they could be transported to the laboratory. Chain of custody procedures similar to those described for the soil samples were observed.

The bailer was subjected to the same three phase cleaning procedures as the split spoon between collection of each water sample. To further assure against contamination, new ropes were used on the bailers for each well sampled.

At the conclusion of water sampling, the static water level in each well was measured over a brief period of time using a chalked steel tape referenced to the surveyed measuring point marked at the top of each well casing. In addition, the level of Lake Washington was surveyed in at this time. This information is provided in Appendix B.

TRENCHING

In an effort to augment the drilling program, a limited amount of trenching was performed on the Port Quendall property. The principal objectives of the trenching were to delineate with some accuracy the alignment or location of the original May Creek channel (1917 to 1930) identified during meetings with Mr. Ward Roberts, and to provide a preliminary assessment of the vertical and lateral distribution and nature of the fill disposed on the site from the Pacific Car and Foundary Company or other sources.

A total of four trenches having a combined or cumulative length of 252 feet were excavated to depths averaging 8 feet using a backhoe with a 36-inch wide bucket. The locations of these trenches are provided in Figure 2.

Upon completion of the excavation, a scale detailed log was made of each trench (Figures 3 and 4). A string level line was placed along one wall of the trench for vertical reference and a reel tape was used along this line for stationing or horizontal control. Following a preliminary visual inspection of the entire trench, significant features including soil types, lithologic contacts, contaminant seeps, cultural debris, and sample locations were sketched in using a small hand tape to provide a reference to the established level line and stationing.

Soil samples were collected at selected locations within the trenches using a small scraper. These samples were placed in sterilized glass jars with teflon lids provided by Laucks Laboratories, Inc. Onsite storage of the samples and transfer procedures to the laboratory were identical to those used for the samples collected from borings. At the conclusion of sampling, each trench was backfilled and the surface restored to its original contour.

LABORATORY ANALYSES

Table 2 lists the various methods used to analyze the soil and water samples and the number of samples analyzed by each method. The soil samples were screened for polycyclic aromatic hydrocarbons (PAH) by absorbence. This method involves methylene chloride extraction, evaporation of the methylene chloride, and re-dissolving the extract in cyclohexane, followed by measurement of the absorbance at 250 nanometers. The absorbence was compared with benzo(a)pyrene standards.

Absorbance was used instead of fluorescence to screen PAHs because of the inability to visually compare fluorescence sample extracts with benzo(a)pyrene standards. This inability is caused by differences in fluorescent color.

Uncertainties in the absorbance screen can be caused by the presence of such compounds as napthalene, acenapthylene, and acenapthene in the extract. These compounds tend to quench absorption of higher ring compounds. Absorption cannot distinguish between PAHs with different numbers of aromatic rings. Further description of the procedure used for the absorption screening is contained in Appendix D-1.

In addition to using the absorbance screen to determine PAH concentrations, a Washington State Department of Ecology (DOE) method was used to determine the PAH concentration in six soil samples for cross-comparison purposes. The DOE method uses a series of extractions to isolate PAH compounds followed by evaporation and weighing. An optional analysis step of the DOE procedure uses high pressure liquid chromatography (HPLC) to separate 2- and 3-ring PAHs from the larger ring PAHs. These larger ring compounds are the only PAHs considered in the DOE definition of an extremely hazardous waste on the basis of PAH content. This optional analysis step was used in the study.

The volatile organic screen for soil samples was performed by an extraction procedure followed by gas chromatographic (GC) analysis. Selected extractions followed by a gas chromatograph/mass spectrometer (GC/MS) scan were used in the analysis for priority pollutants. The GC/MS results provide an additional measure for determining and cross-checking PAH concentrations. Polycyclic aromatic hydrocarbons would appear in the GC/MS scan of the base-neutral extract.

The PAH content of water samples was determined by the same general DOE method used for soil samples. However, the optional HPLC analysis step was followed by measurement of absorption and comparison to benzo(a)pyrene standards.

Volatile aromatics in water were determined by use of a purge-and-trap procedure followed by GC analysis. A photoionization detector was used following passage of the volatiles through the GC.

Pentachlorophenol concentrations in water samples were determined by the Sep-Pak method which involves acidification, passage of the water through an activated Sep-Pak, elution of the Sep-Pak, followed by HPLC analysis. Further discussion of this method is provided in Appendix D-1.

<u>Quality Assurance and Control</u>

A quality assurance/control program was instituted for the laboratory analyses of soil and water samples collected at the Port Quendall property. The program included the use of three techniques:

- replicate analyses for the mineral (inorganic) constituents, 2,4,6-trichlorophenol, pentachlorophenol, benzo(k)fluoranthene, and total PAHs to determine the relative or absolute error in replicate analysis

- spiking studies to define the accuracy of the results obtained on the mineral parameters

- surrogate blind spiking for benzo(k)fluoranthene and 2,4,6-trichlorophenol to define the accuracy of data generated for these parameters.

The results of the replicate analysis and spiking studies are presented in Appendix D. Appendix D-2, which reports the replicate analysis, indicates that the results obtained for the mineral parameters are highly reproducible in spite of the lack of established control limits. The relative error values for the organic parameters indicated that the methods performed very effectively, except in the case of 2,4,6-trichlorophenol. A large disparity between duplicate analyses for the 2,4,6-trichlorophenol indicates that the "standard" analytical methodology used for this compound may need to be modified if extensive monitoring is undertaken on the property. Spiking results presented in Appendix D-3 for the mineral parameters indicate that the data for these compounds is highly accurate. Appendix D-4 presents data for the surrogate recovery of benzo(k)fluoranthene and 2,4,6-trichlorophenol. These data indicate that benzo(k)fluoranthene was present in some of the samples making it an inappropriate choice as a surrogate blind spiking compound and that some samples had a large organic matrix which possessed an affinity for 2,4,6-trichlorophenol, interfering with the extraction process.

The three 2,4,6-trichlorophenol recovery values which indicated an interference were below the lower control limit. These results indicate that the removal of the selected compounds is less than quantitative (100 percent) by the extraction step of the analytical method. This result is neither surprising nor a flaw in the experimental design. It indicates that either the analytical method requires "tuning" to be appropriate for gathering quantitative data, or the data need to be corrected for recovery of 2,4,6-trichlorophenol.

3.0 GEOLOGY

The Port Quendall property is located on a delta/alluvial fan complex which developed at the original mouth of May Creek where it flowed into Lake Washington. The creek has been diverted several times and since 1969, it has flowed in a south-southwesterly direction across the eastern side of the delta/fan, entering Lake Washington at the southern end of the Barbee Mill property. This property is located immediately south of Port Quendall.

Prior to 1916, about three quarters of the delta/fan area exposed today was below lake level. In that year, the ship canal was cut between Lake Washington and Union Lake, resulting in the lowering of Lake Washington from 22 feet to 14 feet above sea level (Liesch et al. 1963). This exposed much of the delta, and since that time considerable filling has been done to accommodate use of the property.

The May Creek delta/fan complex consists of sands, clay, silt, gravel, and in some locations, abundant peat interbeds, all overlain by recent fill. Source materials of the natural deposits include drift and till units incised by the creek.

A cross section drawn roughly on a east-west axis through the center of the property is provided in Figure 5. (The location of the cross section is shown in Figure 2.) As can be seen in the figure, there is too much variability in the materials composing the delta to correlate lithology between the borings used to construct the cross section. Highly variable lithology is typical of alluvial fan/delta complexes where braided channels continuously meander back and forth across the surface, depositing lenses of gravel and coarse sand in channels and finer materials along the flanks, creating an irregular stratigraphic record during the course of deposition.

It is postulated that the May Creek delta/fan is underlain by the lower clay unit described by Liesch et al. (1963) (Qcl on Figure 6). Liesch suggests that this unit is relatively widespread in northwestern King County. It outcrops to the north of the Port Quendall property on Mercer Island and the mainland. The unit underlies the southeastern arm of Lake Washington and Mercer Island, dipping gently westward along both its upper and lower contacts.

The lower clay unit is approximately 50 feet thick and is composed almost entirely of gray, blue, and brown clay and silt. The unit is thick bedded to laminated and was deposited for the most part in standing water, with the clay being locally varved. Wells drilled into the lower clay unit in northwest King County are reported to yield little water. It appears that the unit acts as an aquitard, inhibiting the downward movement of water from younger sediments.

The total thickness of the May Creek delta/fan is not yet known. the delta/fan was not penetrated during the drilling program conducted for this study. A previous exploration program (Twelker 1971) with borings up to 61 feet deep does not appear to have reached the bottom of the delta/fan either since a stratigraphic unit similar to the lower clay unit is not shown on the cross sections generated from that program.

Twelker (1971) indicates that the delta/fan can be divided into at least an upper and lower unit. He has described the upper unit as a loose to medium-dense sand with thin layers of peat and silt. The lower unit consists of dense sand with gravel lenses and no peat. Based on this description, borings conducted for the current study were located in the upper unit of the delta/fan.

Trench T-1 cut across the original May Creek channel on the east side of the Port Quendall property (Figures 2 and 3). The log for this trench clearly defines the margins of a channel containing clay, sand and gravel lenses, and abundant cultural debris including tar fragments, bricks, and wood. The delta deposits flanking the channel, as well as the channel itself, appear to be overlain by a relatively recent aggregate fill averaging two feet in thickness with a thin silt layer at the surface.

Trench T-2 was located near the center of the old May Creek channel. The stratigraphic relationship between the channel and fill deposits in this trench was similar to that of trench T-1 (Figure 3). Mobile creosote began to seep from the walls of T-2 at several levels throughout the time that the excavation was open.

Trench T-3 was sited along the center line of the original May Creek channel. The log for this trench shows the somewhat irregular but distinctive erosional contact of the channel with underlying delta/fan deposits (Figure 3). Channel deposits exposed in the T-3 excavation consisted of sand, silt, metal, and tar fragments. Mobile creosote seeped from the channel section of the walls of the trench during the time that the excavation was exposed. An iridescent sheen appeared on the surface of groundwater which accumulated in the floor of the trench accompanied by a heavy hydrocarbon odor. Channel and delta/fan deposits in the trench were covered by a 2- to 3-foot thick mantle of fill consisting of silt and wood fibre shavings.

Trench T-4 was positioned to determine the type of fill or possible contaminants present in the area reported to have been used for industrial fill from the Pacific Car and Foundary Company. The log for T-4 (Figure 4) shows a variety of semi-stratified fill materials including sand, tar fragments, metal, brick, glass, and wood fiber. In addition, mobile creosote seeped from the walls near the south end of the trench at the time it was excavated. It appears that undisturbed delta/fan deposits consisting of sand and gravel with clay lenses occupied the lower 1/4 to 1/2 of the trench between approximately Station 0 and Station 42 (Figure 4). A seep or spring line is present along the top of the undulating contact between the delta/fan and overlying fill material near the south end of the trench.

Boring BH-5 was located approximately 17 feet from the south end of Trench T-4. Contamination was noted as deep as 20 feet in that boring. By extrapolation, it is conceivable that contamination may exist to at least that depth in permeable materials below Trench T-4, having migrated from upper horizons. On the basis of findings in Trench T-4, it would appear that contaminated fill covers much of the area north of the tank farm (Figure 2).

4.0
HYDROLOGY

Groundwater hydrology characteristics may vary across the Port Quendall property in response to the variability in the stratigraphy and lithology of the May Creek delta/fan sediments. However, some general trends in the groundwater regime can be identified.

Recharge of the groundwater aquifer on the property occurs primarily in the upper reaches of the May Creek drainage basin, which covers approximately 8100 acres (CH_2M-Hill 1977). However, some recharge also occurs by infiltration of precipitation that falls directly on the site. The surface of the groundwater table on the property slopes toward the northwest, and varies from a mapped elevation of almost 19 feet near the site of the former Rielly Tar and Chemical Company still house to about 15 feet at Lake Washington (Figure 7). This results in a groundwater surface gradient of about 42 feet/mile (0.0079 foot/foot) with a total hydraulic head of about 6 feet across the property. Based on an examination and review of the local geology, the stratigraphy exposed in exploration borings, and the study of the depositional environment of the May Creek delta/fan, it is interpreted that groundwater discharge is into the sub-bottom of Lake Washington in the near shore environment.

Although the groundwater surface on the property is generally uniform (as indicated by the generally uniform pattern of the water level surface contours), there are some variations. For example, in the southwestern portion of the property, near boring BH-12, the groundwater surface contours become closely spaced and skewed toward the shoreline of Lake Washington (Figure 7). At this location, the groundwater gradient increases to about 95 feet/mile (0.018 foot/foot) and may reflect local semi-confined groundwater conditions resulting from the variable nature of the delta/fan sediments. In the northeastern corner of the property, the water level contours are less closely spaced resulting in a lower gradient of about 19 feet/mile (0.0036 foot/foot). This variation may also be caused by the variable nature of the sediments.

A study of the coefficient of transmissibility across the property, as calculated from pump tests at selected wells, illustrates the variability of local groundwater flow. Transmissibility of an aquifer is a measure of the rate of flow of water subject to a unit hydraulic head through a vertical strip of soil one foot high. In general, relatively high values of transmissibility indicate high rates of groundwater movement. Table 3 lists the calculated values of transmissibility at five selected wells on the Port Quendall property. Based on estimates of saturated thickness provided in the boring logs and estimates of representative porosity for the sediments, the velocity of groundwater travel at each boring was estimated. As indicated in Table 3, the estimated groundwater velocities across the site vary from about 7 feet/year to almost 60 feet/year and are greatest near the center and southwestern portion of the property.

0.019 ft/day

0.16 ft/day

5.0
CHEMICAL RESIDUES

The following section provides a preliminary evaluation of the location and levels of chemical residues present in the soils and water of the Port Quendall property. The purpose of this information is to guide the development of remedial actions for the property.

SOILS

As discussed in Section 2.0, 124 soil samples from the Port Quendall property were screened for PAH concentrations by an absorbance technique. This technique provided a cost-effective method for determining semi-quantitative PAH levels in a large number of samples. Table 4 provides a quality assurance comparison of six soil samples simultaneously analyzed for PAHs by the absorption technique and the DOE gravimetric method. The PAH concentrations determined by the absorption and DOE methods agreed within a factor of three for four of the six samples and within a factor of 30 for the remaining two samples. Agreement within a factor of three is considered good when the relatively low concentrations of PAHs, nonspecificity of the absorbance screen (i.e., does not exclude 2- and 3-ring compounds which are not considered in the DOE definition of PAHs), and potential uncertainties in the screen concentrations are taken into account. The agreement between the methods for the one sample with greater than 0.1 percent PAH was particularly good. The PAH concentrations of three samples determined by GC/MS scans (Table 4) are much lower than the results of the other two methods. This could be indicative of the uncertainties of quantitative analyses by GC/MS without analyzing standards for the compounds of specific concern.

Table 5 lists the results of the absorbance screen for PAHs and Figure 8 presents a spatial plot of these data. The highest concentration of PAHs was 4.8 percent (weight percent as benzo(a)pyrene), found at a depth of 4.5 to 6 feet in borehole BH-1. This borehole is located on the northern end of the property. Polycyclic aromatic hydrocarbons at concentrations equal to or greater than one percent were present in some samples from all of the borings and trenches except in the southeastern (boreholes BH-10, BH-11, BH-12, BH-14, and BH-15) and extreme western (borehole BH-2 and trench T-2) portions of the property. Soils with a PAH concentration of one percent (when more than 400 pounds of material are present) are defined as "extremely hazardous waste" by the DOE.

It is possible that significant near-surface concentrations of PAHs could be present in borehole BH-10. A soil sample taken from 0 to 1.5 feet in this hole had a PAH concentration of 0.63 percent. The actual concentration could be higher because of analytical uncertainty or a heterogeneous occurrence of PAHs in this zone. Additional samples from trench T-2 could also reveal significant PAH concentrations since one of the two samples collected from the trench has a concentration of 0.50 percent.

Tables 6 and 7 show non-PAH priority pollutants and other compounds detected in the soil samples. Based on GC/MS scans, aromatic hydrocarbons with two and three aromatic rings were present at levels of approximately 100 to 2000 mg/kg (ppm) in composite soil samples from boreholes BH-7 and BH-9 (Table 6). It should be noted that two and three aromatic-ring hydrocarbons are not considered in the DOE definition of PAHs because of their lower toxicity relative to higher ring compounds.

The detected two-ring compounds were napthalene, 2-methylnapthalene, acenapthene, acenapthylene, anthracene, and fluorene. The detected three-ring compounds were fluoranthene and phenanthrene. Napthalene was the compound present at the highest level in the samples, with concentrations of 1139 ppm (0.11 percent) and 2168 ppm (0.22 percent) in samples from BH-7 and BH-9, respectively. These concentrations should be regarded as only semi-quantitative since standards for the specific two-and three-ring compounds were not run with the samples.

Volatile organics were detected by GC/MS scan in the ppm concentration range in the composite soil samples from BH-7 and BH-9 (Table 6). This level of volatile organics was also present in the sample from the 12.9 to 14.4-foot interval of BH-9 (Table 7). The volatile organics detected in the samples included aromatic compounds (benzene, toluene, xylene, methylbenzene/styrene, and ethylbenzene) and one halogenated aliphatic compound (methylene chloride).

Other non-PAH compounds detected in the soil samples include:

- acid-extractable phenolic compounds at the ppm level (the priority pollutant 2,4-dimethylphenol and two non-priority compounds)

- base-neutral extractable non-priority compound at the ppm level (dibenzofuran)

- pesticides at the part-per-billion (ppb) level (aldrin, lindane, and possibly heptachlor epoxide).

Other tentatively identified compounds from the GC/MS scan of the composite soil samples are included in Appendix D.

Except for halogenated organics, the DOE hazardous waste criteria do not specifically address non-PAH compounds. Criteria for definition of a "dangerous waste" or "extremely dangerous waste" exist that are based on total equivalent concentrations and quantities of mixtures of chemicals based on their carcinogenic and toxic properties. Wastes exceeding 400 pounds that contain halogenated hydrocarbon concentrations of 0.01 to 1.0 percent are considered to be a "dangerous waste" by the state. Composite soil samples from BH-7 and BH-9 have only 0.002 and 0.004 percent, respectively, of halogenated organics (methylene chloride).

It does not appear that the field exploration program reached the bottom of contamination on the Port Quendall property. Levels of PAH approaching one percent were found at the 21.6 to 23-foot interval of borehole BH-5. Twelker (1971) found hydrocarbon odor near the bottom of holes drilled to a depth of approximately 60 feet, although this could have easily been the result of contamination carried down from much higher horizons.

WATER

Based on an analysis of inorganic constituents (Appendix D), the groundwater on the property is fresh (i.e., low dissolved solids) and varies in hardness from moderately hard (61 to 120 mg/l of $CaCO_3$) to very hard (more than 180 mg/l of $CaCO_3$). The pH of water varies from slightly acidic (6.1) to slightly alkaline (7.8).

Table 8 lists the results of the organic analyses of the water samples and Figure 8 provides a spatial plot of these data. Polycyclic aromatic hydrocarbons were present in all 12 groundwater samples from the property, ranging in concentration from 6 ug/l to 23 mg/l.

ppb ppm

The DOE uses water quality criteria recommended by the U.S. Environmental Protection Agency (EPA) in the November 28, 1980 Federal Register for their evaluation of potential priority pollutants in water (personal communication, G. Brugger, DOE, August, 1983). The EPA does not have recommended limits for PAHs, although toxicity and risk-level data are presented.

Polycyclic aromatic hydrocarbon concentrations greater than 1 mg/l were present in water samples from wells BH-5, BH-5A, BH-8, BH-8A, and BH-2A. With the exception of water samples from wells BH-2A and BH-12A, groundwater containing more than 100 ug/l of PAHs occurred in wells where soil samples had more than one percent PAHs. In wells where soil samples were found to have less than one percent PAHs, the corresponding water samples contained less than 100 ug/l of these compounds (Figure 8). In general, PAH concentrations were higher in shallow groundwater than in deeper groundwater samples.

The PAH concentration in the water sample from well BH-2A (2.64 mg/l) appears to be anomalously high. Soil from boring BH-2 had very low PAH concentrations and water from well BH-2, which is adjacent to well BH-2A and screened at the same depth interval, had a PAH concentration of only 5.7 ug/l. The anomalously high value could possibly be the result of cross-contamination during sampling.

The PAH concentration in the water from BH-12A (745 ug/l) appears to be high relative to the low soil PAH concentrations in the boring (0.004 percent maximum). The high PAH concentration in the water could be due to migration of these compounds from up-gradient sources along the old May Creek channel. The high concentration could also be a result of cross-contamination during sampling.

Volatile aromatic hydrocarbons were present at detectable concentrations in 8 of the 12 groundwater samples. Benzene, toluene, and xylene (BTX) concentrations ranged from several ug/l to approximately 17 mg/l. The concentrations of each of these compounds were generally equal to or greater than 1 mg/l in samples from wells BH-5, BH-5A, BH-8, and BH-8A. It should be noted that boreholes BH-5 and BH-8 had the highest soil PAH concentrations. It is possible that the high PAH values were observed as a result of their extraction from soil by the BTX solution. The absence of detectable volatile organics in the water sample from BH-2A is further evidence that the high PAH reading for the sample is anomalous.

Four of the groundwater samples were analyzed for pentachlorophenol. Only the sample from BH-8 contained a detectable concentration of this compound (86 ug/l). No concentration limits for aromatic hydrocarbons or pentachlorophenol have been promulgated by the EPA for freshwater aquatic life or human health, although toxicity and risk-level data have been presented in the Federal Register.

6.0

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Table 1. MONITORING WELL INSTALLATIONS

Well	Total Depth (ft)	Ground Elev. (ft)	M.P. Elev[a] (ft)	Dia. (in)	Material	Monitored Interval (ft)	North Coordinate	East Coordinate
BH-1	19.5	23.4	23.42	2	PVC	5-19.5	197,782	1,662,516
BH-2	19.5	20.8	25.47	2	PVC	5-19.5	197,633	1,662,767
BH-2A	20.0	20.8	25.06	4	Stainless	5-20.0	197,630	1,662,762
BH-5	32.0	32.3	25.64	4	PVC	13-23.0	197,473	1,662,136
BH-5A	10.0	23.3	24.38	4	PVC	5-10.0	197,406	1,662,136
BH-6	19.5	20.0	21.85	4	PVC	8-18.0	197,406	1,662,227
BH-8	24.5	23.4	25.12	4	PVC	13-23.0	197,342	1,662,426
BH-8A	10.0	23.4	23.64	4	PVC	5-10.0	197.336	1,662,426
BH-10	19.5	21.5	22.50	4	PVC	5-19.5	197,331	1,662,981
BH-12	23.0	21.9	24.39	4	PVC	13-23.0	197,106	1,662,862
BH-12A	10.0	21.9	21.41	4	PVC	5-10.0	197,106	1,661,855
BH-15	19.5	21.9	21.70	2	PVC	5-19.5	196,970	1,661,914

Note: Parentheses with coordinates indicates survey by WCC personnel. All other survey data obtained by Ken J. Oyler, CE & LS #5524.

[a] M.P. denotes measuring point at top of installed casing used for various hydrologic measurements.

Table 2. ANALYTICAL METHODS USED FOR THE ANALYSIS OF SOIL AND WATER SAMPLES

Parameter	Number of Samples	Method
SOIL[a]		
PAH[b] Screen	124	Absorbance of extract
Total Soil PAHs	6	Appendix G of 173-303 WAC[c] (3/82)
Volatile Organic Screen	6	EMSL-LV[d] No. 1 (11/10/81)
Priority Pollutants	2 Composites (all fractions), 3 samples (base-neutral extract only)	EMSL-LV No. 2 (11/10/81) for extraction; EPA methods 624 and 625 for analysis
WATER		
PAHs	12	Appendix G of 173-303 WAC, 3/82
Volatile Aromatics	12	EPA Method 602
Pentachlorophenol	4	Sep-Pak Method
pH	12	EPA Method 150.1
Total Alkalinity	12	EPA Method 310.2
Conductivity	12	EPA Method 120.1
Sodium	12	EPA Method 273.1
Calcium	12	EPA Method 215.1
Magnesium	12	EPA Method 242.1
Potassium	12	EPA Method 258.1
Chloride	12	EPA Method 325.1
Sulfate	12	EPA Method 375.4
Nitrate-Nitrite	12	EPA Method 353.2
Total Phenols	3	EPA Method 420.1

[a] Boring and trench soil samples.

[b] Polycyclic aromatic hydrocarbons.

[c] Washington State Administrative Code.

[d] U.S. EPA Environmental Measurement System Lab. - Las Vegas.

Table 3. CHARACTERISTICS OF GROUNDWATER MOVEMENT ON THE PORT QUENDALL PROPERTY

Well Number	Transmissibility gpd/ft	Estimated Velocity, ft/yr	ft/day
BH-2A	104	7.3	0.02
BH-6	453	58.4	0.16
BH-8	76	7.3	0.02
BH-10	250	18.3	0.05
BH-15	484	32.9	0.09

Table 4. CROSS-COMPARISON OF PAH CONCENTRATIONS DETERMINED BY DIFFERENT METHODS

	Sample (Concentration % by weight)						
Method	BH-2/D-2	BH-4/D-4	BH-6/D-4	BH-9/D-7	BH-10/D-5	BH-11/D-8	BH-7 Comp.
Absorbance Screen[a]	0.002	0.44	0.01	0.03	0.002	0.01	0.74–0.97
DOE Method	0.057	0.46	0.03	0.06	0.064	0.02	-
GC/MS (2 or 3 aromatic rings)	—	0.031	—	—	—	0.0005	0.27[b]
(more than 3 aromatic rings)	—	0.015	—	—	—	0.0006	0.07[b]

[a] Concentration in terms of percentage as benzo(a)pyrene.

[b] Based on both readily identifiable compounds and tentatively identified compounds.

Note: Refer to Table 2 for analytical methods.

Table 5. ANALYTICAL RESULTS FOR POLYCYCLIC AROMATIC HYDROCARBON (PAH) SCREENING OF SOIL SAMPLES FROM THE QUENDALL PROPERTY[a]

Boring	Sample	Location[b]	Depth (feet)	PAH Concentration[c]
Boring Samples				
BH-1	D-1		0-1.5	0.002
	D-2		3-4.5	0.93
	D-3		4.5-6	4.8
	D-4		6-7.5	L/0.002
	D-5		7.5-9	0.001
	D-6		12.9-14.4	0.004
	D-7		18-19.5	0.009
BH-2	D-1		0-1.5	L/0.001
	D-2		3-4.5	0.002
	D-3		4.5-6	0.003
	D-4		6-7.5	L/0.001
	D-5		7.5-9	L/0.001
	D-6		12.9-14.4	0.001
	D-7		18-19.5	L/0.001
BH-4	D-1		0-1.5	L/0.001
	D-2		4.5-6	0.002
	D-3		9-10.5	0.056
	D-4		10.5-12.0	0.44
	D-5		12.9-14.4	3.4
	D-6		18-19.5	0.75
	D-7		21.7-23.2	0.041
BH-5	D-1		0-1.5	0.73
	D-2		1.5-3	1.0
	D-3		3-4.5	0.90
	D-4		4.5-6	0.89
	D-5		6-7.5	0.89
	D-6		7.5-9	0.006
	D-7		12.9-14.4	0.006
	D-8		18-19.5	1.9
	D-9		21.6-23.1	0.71
BH-6	D-1		3-4.5	1.0
	D-2		4.5-6	0.023
	D-3		6-7.5	0.94
	D-4		7.5-9	0.01
	D-5		12.9-14.4	0.002
	D-6		18-19.0	0.001

Table 5. ANALYTICAL RESULTS FOR POLYCYCLIC AROMATIC HYDROCARBON (PAH) SCREENING OF SOIL SAMPLES FROM THE QUENDALL PROPERTY[a] (continued)

Boring	Sample	Location[b]	Depth (feet)	PAH Concentration[c]
BH-7	D-1		3-4.5	0.91
	D-2		4.5-6	0.081
	D-3		6-7.5	0.74
	D-4		7.5-9	0.97
	D-5		9-10.5	0.88
	D-6		12.9-14.4	0.001
	D-7		18-19.0	0.008
BH-8	D-1		0-1.5	0.86
	D-2		1.5-3	0.054
	D-3		3-4.5	0.013
	D-4		4.5-6	0.94
	D-5		6-7.5	1.2
	D-6		7.5-9	1.1
	D-7		12.9-14.4	1.8
	D-8		18-19.5	1.3
	D-9		23-24.5	0.042
BH-9	D-1		0-1.5	0.005
	D-2		1.5-3	1.7
	D-3		3-4.5	2.2
	D-4		6-7.5	1.3
	D-5		7.5-9	0.014
	D-6		9-10.5	1.0
	D-7		12.9-14.4	0.03
	D-8		18-19.5	L/0.001
BH-10	D-1		0-1.5	0.63
	D-2		1.5-3	0.009
	D-3		3-4.5	0.002
	D-4		4.5-6	0.002
	D-5		6-7.5	0.002
	D-6		12.9-14.4	L/0.001
	D-7		18-19.5	L/0.001
BH-11	D-1		0-1.5	0.007
	D-2		1.5-3	0.017
	D-3		3-4.5	0.002
	D-4		4.5-6	0.002
	D-5		6-7.5	0.003
	D-6		7.5-9	0.003
	D-7		12.9-14.4	L/0.001
	D-8		18-19.5	0.01

Table 5. ANALYTICAL RESULTS FOR POLYCYCLIC AROMATIC HYDROCARBON (PAH) SCREENING OF SOIL SAMPLES FROM THE QUENDALL PROPERTY[a] (continued)

Boring	Sample	Location[b]	Depth (feet)	PAH Concentration[c]
BH-12	D-1		1.5-3	0.004
	D-2		3-4.5	L/0.001
	D-3		4.5-6	0.001
	D-4		6-7.5	0.003
	D-5		12.9-14.4	0.001
	D-6		18-19.5	0.003
	D-7		21.9-23.4	L/0.001
BH-14	D-1		0-1.5	0.022
	D-2		3-4.5	0.007
	D-3		4.5-6	0.007
	D-4		6-7.5	L/0.001
	D-5		7.5-9	0.009
	D-6		12.9-14.4	L/0.001
	D-7		18-19.5	L/0.001
BH-15	D-1		0-1.5	0.004
	D-2		3-4.5	0.008
	D-3		4.5-6	0.002
	D-4		6-7.5	L/0.001
	D-5		7.5-9	L/0.001
	D-6		12.9-14.4	0.002
	D-7		18-19.5	0.001
BH-16	D-1		0-1.5	0.004
	D-2		1.9-3.4	1.1
	D-3		3.4-4.9	0.001
	D-4		4.9-6.4	L/0.001
	D-5		6.4-7.9	d
	D-6		7.9-9.4	L/0.001
	D-7		9.4-10.9	L/0.001
	D-8		12.9-14.4	L/0.001
	D-9		18-19.5	L/0.001
Trench Samples				
T-1	1	39.1	2.5	0.67
	2	39.1	3.8	0.73
	3	39.1	5.0	0.008
	4	31.9	4.4	0.37
	5	47.8	3.1	1.3

Table 5. ANALYTICAL RESULTS FOR POLYCYCLIC AROMATIC HYDROCARBON (PAH) SCREENING OF SOIL SAMPLES FROM THE QUENDALL PROPERTY[a] (concluded)

Boring	Sample	Location[b]	Depth (feet)	PAH Concentration[c]
T-1 (cont.)	6	20.0	5.6	0.002
	7	46.9	5.6	L/0.001
	8	39.1	1.3	L/0.001
T-2	1	7.5	2.0	0.002
	2	6.3	3.75	0.50
T-3	1	19.7	3.75	0.32
	2	19.7	5.3	0.84
	3	19.7	7.5	1.0
	4	30.6	5.9	1.2
T-4	1	100.6	4.7	1.9
	2	100.6	6.6	0.43
	3	100.6	8.1	0.080
	4	51.0	3.1	0.28
	5	51.0	5	0.48
	6	51.0	6.9	1.7

[a] Screening by measurement of absorbance of extract and comparison to benzo(a)pyrene standards.

[b] Feet from southern end of trench.

[c] % PAH by weight of soil as benzo(a)pyrene; L/# = Below detection level of #.

[d] Sample not analyzed.

Table 6. CONCENTRATIONS OF TOTAL PAHS AND SELECTED NON-PAH COMPOUNDS DETECTED IN GC/MS SCANS OF EXTRACTS OBTAINED FROM TWO SOIL COMPOSITES[a]

Extract	Compound	Concentration (ppb) BH-7 Comp	Concentration (ppb) BH-9 Comp
Acid	2,4-Dimethylphenol[b]	27,500	L/4,000
	2-Methylphenol	15,700	7,800
	4-Methylphenol	30,400	L/2,000
Base/Neutral	Total PAH Compounds (>3 rings)[b,c]	650,600	1,204,400
	Acenapthene[b]	159,300	515,000
	Fluoranthene[b]	166,800	368,000
	Napthalene[b]	1,139,000	2,168,000
	Acenapthylene[b]	71,500	185,000
	Anthracene[b]	74,400	258,000
	Fluorene[b]	96,500	279,000
	Phenanthrene[b]	304,300	1,061,000
	Dibenzofuran	72,900	139,000
	2-Methylnapthalene	265,000	1,083,000
Volatile	Benzene[b]	1,130	2,300
	Ethylbenzene[b]	27,000	34,600
	Methylene Chloride[b]	19,300	36,700
	Toluene[b]	10,150	12,000
	O-Xylene	58,400	56,900
Pesticides	Aldrin[b]	7	130
	Heptachlor Epoxide[b,d]	L/100	50
	Lindane[b]	L/100	180

[a] Only priority pollutants and readily identifiable non-priority pollutants are listed. Other tentatively-identified compounds are listed in Appendix D. Two and three ring aromatic compounds (which are not considered to be PAHs by the Washington State DOE) are listed.

[b] Priority pollutants.

[c] Includes only readily identifiable compounds.

[d] Possible positive matrix interference.

Table 7. RESULTS OF THE SCAN FOR VOLATILE ORGANIC COMPOUNDS IN THE SOIL SAMPLES[a]

Compound	Sample					
	BH-2/D-2	BH-4/D-4	BH-6/D-4	BH-9/D-7	BH-10/D-5	BH-11/D-8
Benzene	L/0.2	0.3	L/0.2	2.1	L/0.2	L/0.2
Toluene	L/0.2	L/0.2	L/0.2	5.2	L/0.2	L/0.2
Xylene	L/0.4	L/0.4	L/0.4	7.3	L/0.4	L/0.4
Methyl-benzene & Styrene	L/0.4	L/0.4	L/0.4	4.3	L/0.4	L/0.4

[a] Concentration in units of ppm; L/# = Below the detection level of #.

Table 8. CONCENTRATIONS OF SELECTED ORGANIC CONSTITUTENTS IN WATER SAMPLES

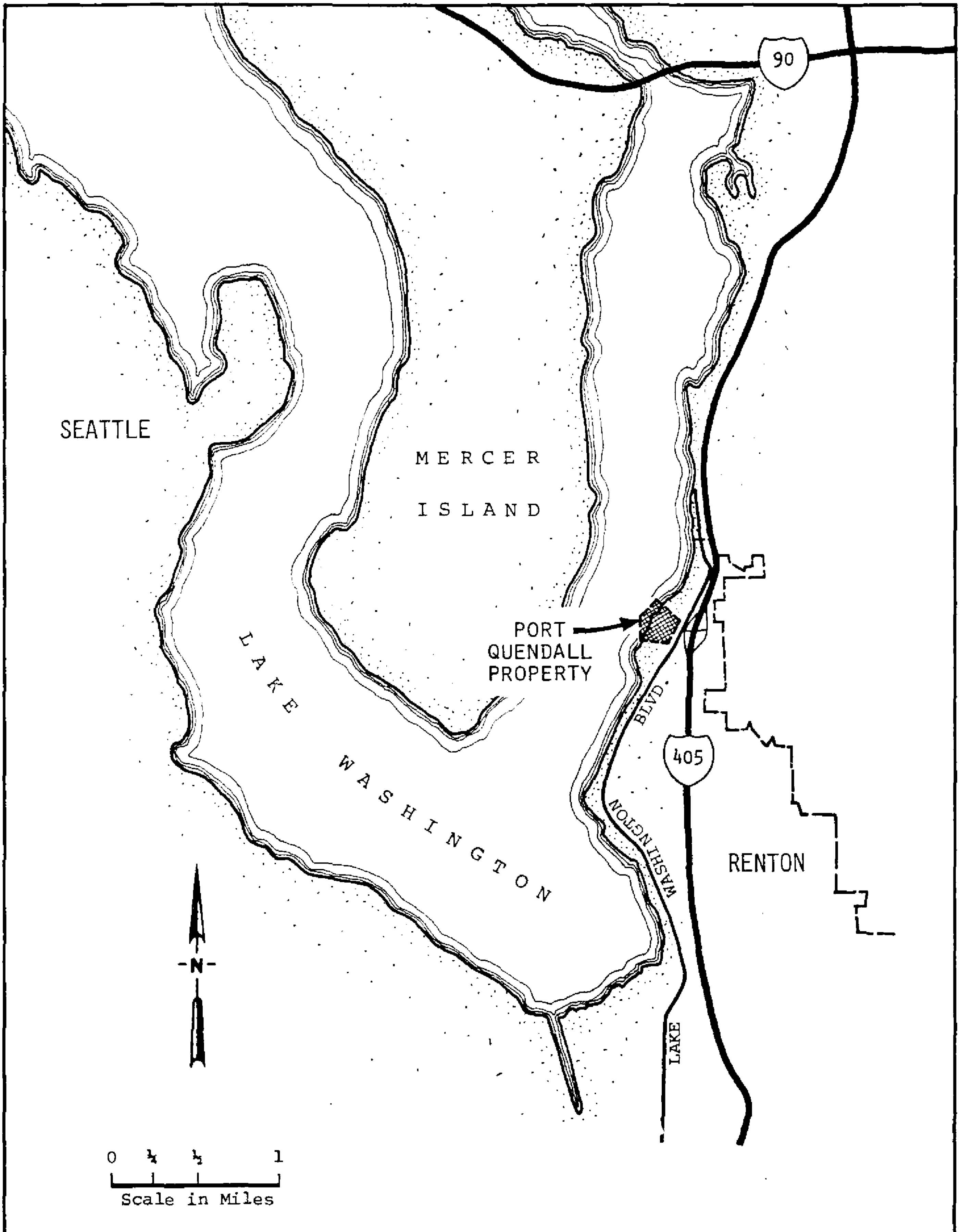
Parameter	Sample Concentration[a,b] (μg/l)											
	BH1	BH2	BH2A	BH5	BH5A	BH6	BH8	BH8A	BH10	BH12	BH12A	BH15
Depth Screened (feet)	5-19.5	5-19.5	5-20.0	13-23	5-10	8-18	13-23	5-10	5-19.5	13-23	5-10	5-19.5
PAH[c]	115	5.7	2640	4240	5210	930	1839	22,700	12.8	6.8	745	10.4
Benzene	L/1.0	L/1.0	L.1.0	17,000	980	94	7,000	14,000	24.0	L/1.0	L/1.0	L/1.0
Toluene	L/1.0	L/1.0	L/1.0	17,000	640	39	4,100	9,200	L/1.0	L/1.0	L/1.0	L/1.0
Xylene	2.1	L/1.0	L/1.0	17,000	490	150	5,200	4,600	5.0	L/1.0	L/1.0	6.0
Penta-chloro-phenol	L/10	L/10	L/10	--	--	--	86	--	--	--	--	--

[a] L/# = Below detection level of #.

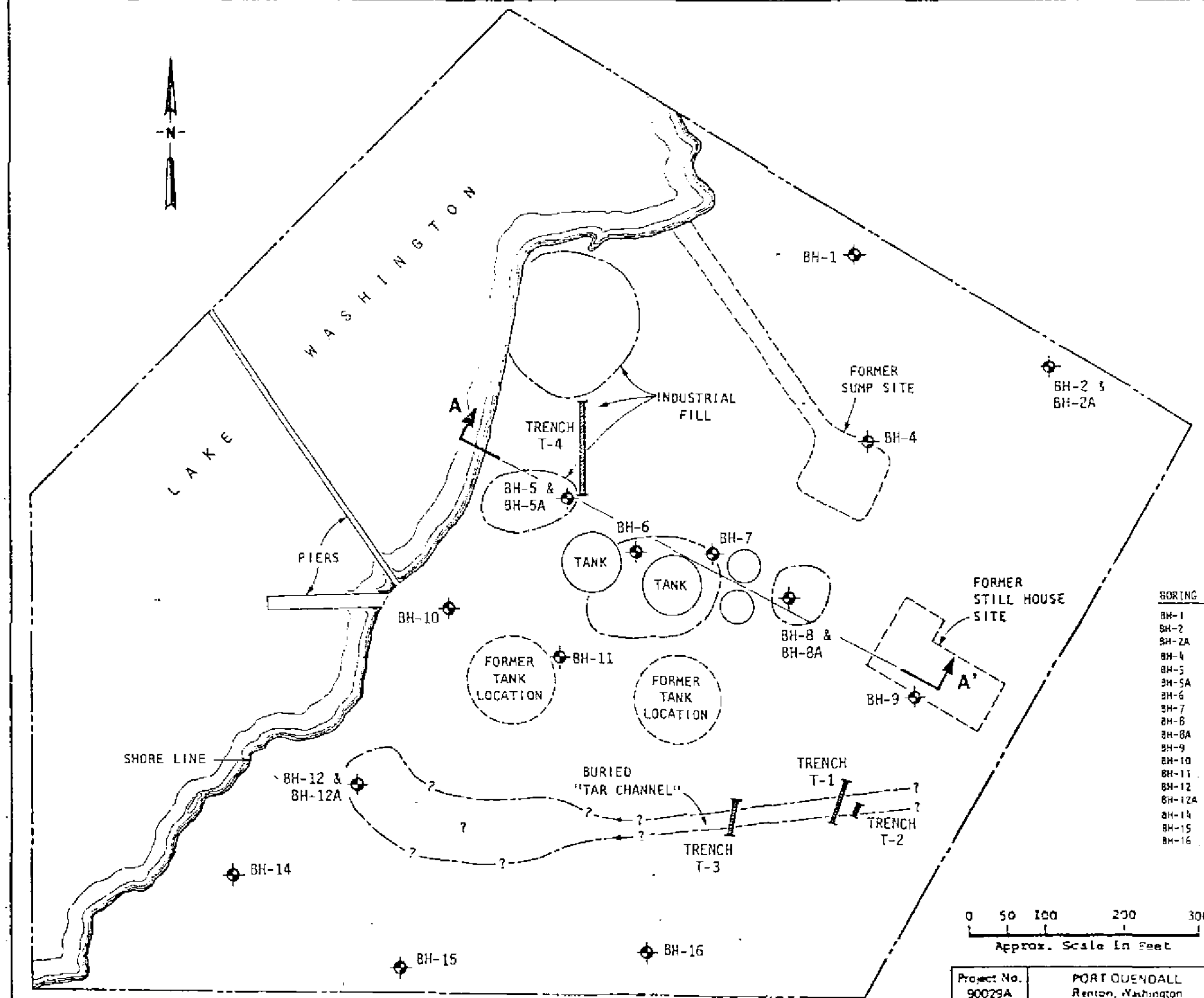
[b] The sample name reflect the well from which the sample was collected.

[c] μg/L as benzo(a)pyrene, corrected for napthalene; by Washington State Dept. of Ecology Method.

Note: Refer to Table 2 for analytical method.



Project No. 90029A	PORT QUENDALL Renton, Washington	LOCATION OF PORT QUENDALL PROPERTY	Figure 1
Woodward-Clyde Consultants			

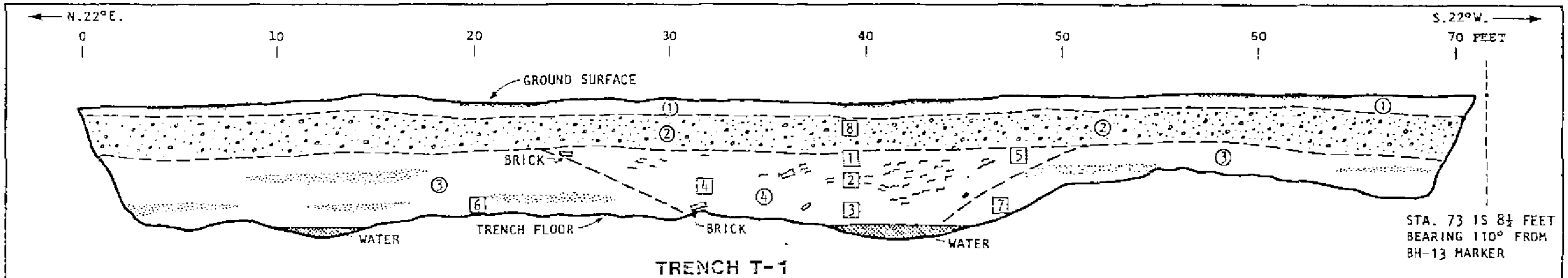


LEGEND:

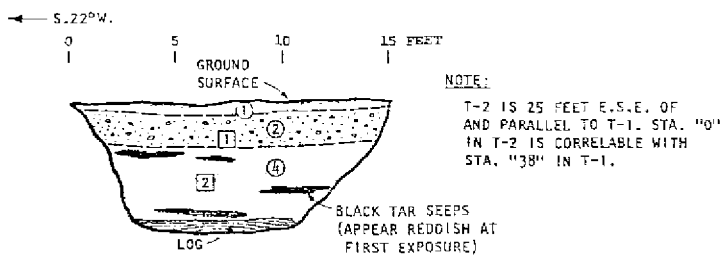
BORING LOCATION

BORING	NORTH	EAST	ELEVATION (GL.)		COMMENTS
BH-1	197,782	1,662,516	23.4	ft.	-
BH-2	197,633	1,662,267	20.8	"	-
BH-2A	"	"	"	"	5.7' W.S.W.
BH-4	197,541	1,662,532	24.1	"	-
BH-5	197,473	1,662,136	23.3	"	-
BH-5A	"	"	"	"	4.5' N.
BH-6	197,406	1,662,227	20.0	"	-
BH-7	197,400	1,662,329	19.5	"	-
BH-8	197,342	1,662,426	23.4	"	-
BH-8A	"	"	"	"	6' S.
BH-9	197,214	1,662,575	25.1	"	-
BH-10	197,331	1,661,941	21.5	"	-
BH-11	197,269	1,662,126	20.5	"	-
BH-12	197,106	1,661,362	21.9	"	-
BH-12A	"	"	"	"	6.5' W.
BH-14	196,993	1,661,700	19.7	"	-
BH-15	196,970	1,661,914	21.9	"	-
BH-16	195,887	1,662,237	24.4	"	-

Project No. 90029A	PORT QUENDALL Renton, Washington	BORING AND TRENCH LOCATIONS	Figure 2
Woodward-Clyde Consultants			



TRENCH T-1



TRENCH T-2

UNIT DESCRIPTIONS FOR T-1 & T-2

① ORGANIC SILT (MH): Dark brown to black, highly plastic with abundant fibre debris (wood).

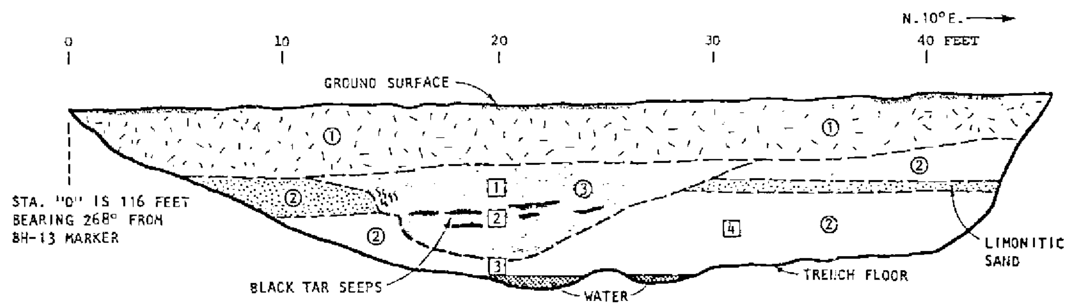
② SANDY GRAVEL (GP): Light brown to buff; 1" minus rounded gravel & sand aggregate fill. Wood fibre along lower contact.

③ SILTY SAND TO SANDY SILT (SM-ML): Gray to brown, damp, medium to fine sand, occasional coarse lenses.

④ CHANNEL DEPOSITS: Mottled clay, sand and gravel lenses interspersed with cultural debris including tar, bricks & wood.

TAR FRAGMENTS

4 SAMPLE LOCATION AND NUMBER



TRENCH T-3

UNIT DESCRIPTIONS FOR T-3

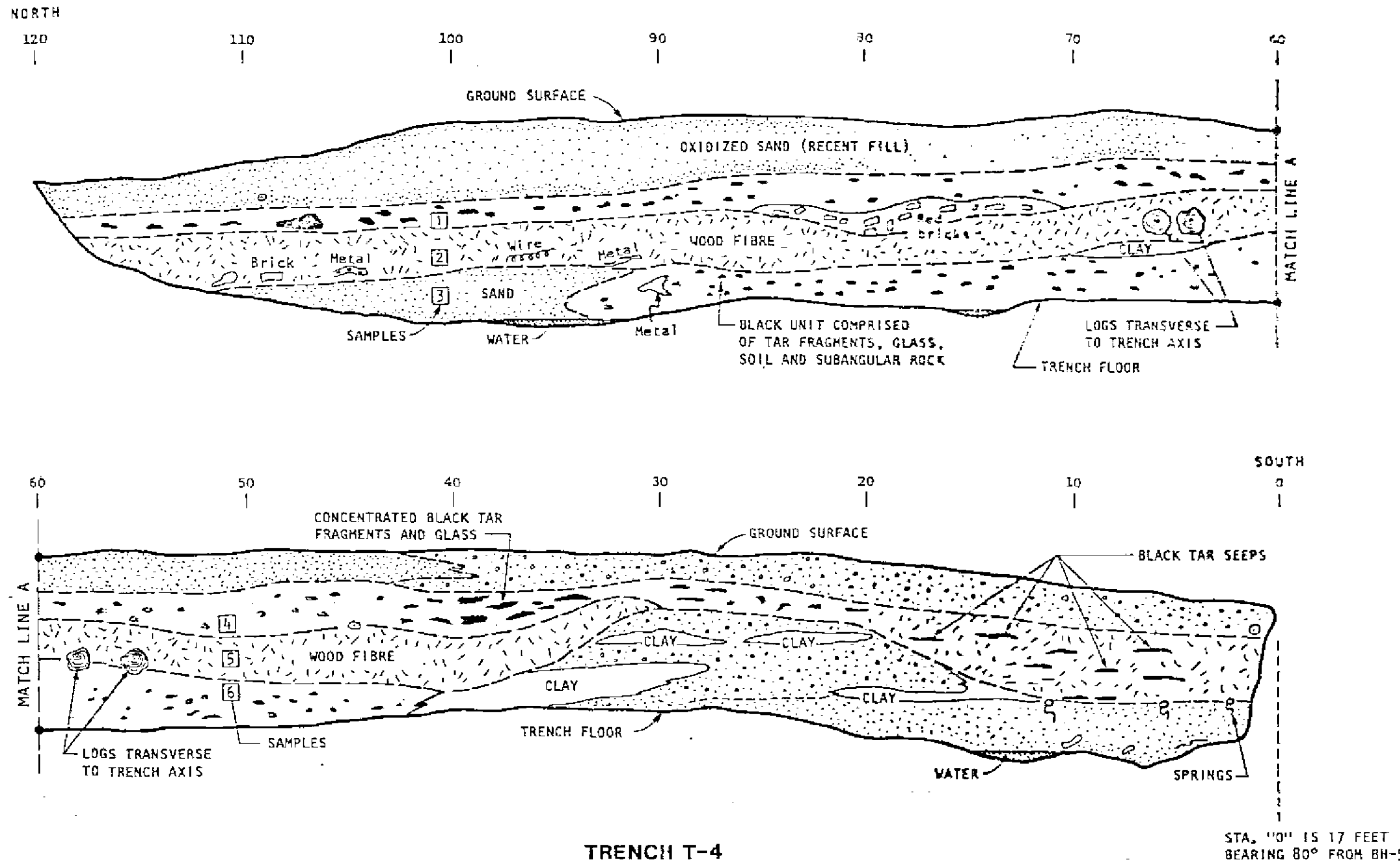
① FILL: Clayey organic silt, black, abundant wood fibre and rootlets.

② SILTY SAND TO CLAYEY SAND (SM-SP): Olive brown to gray, occasional continuous thin sand beds.

③ CHANNEL DEPOSITS: Abundant cultural debris including metal & tar fragments, wood, and tar seeps. Pronounced odor with iridescent sheen on groundwater surface.

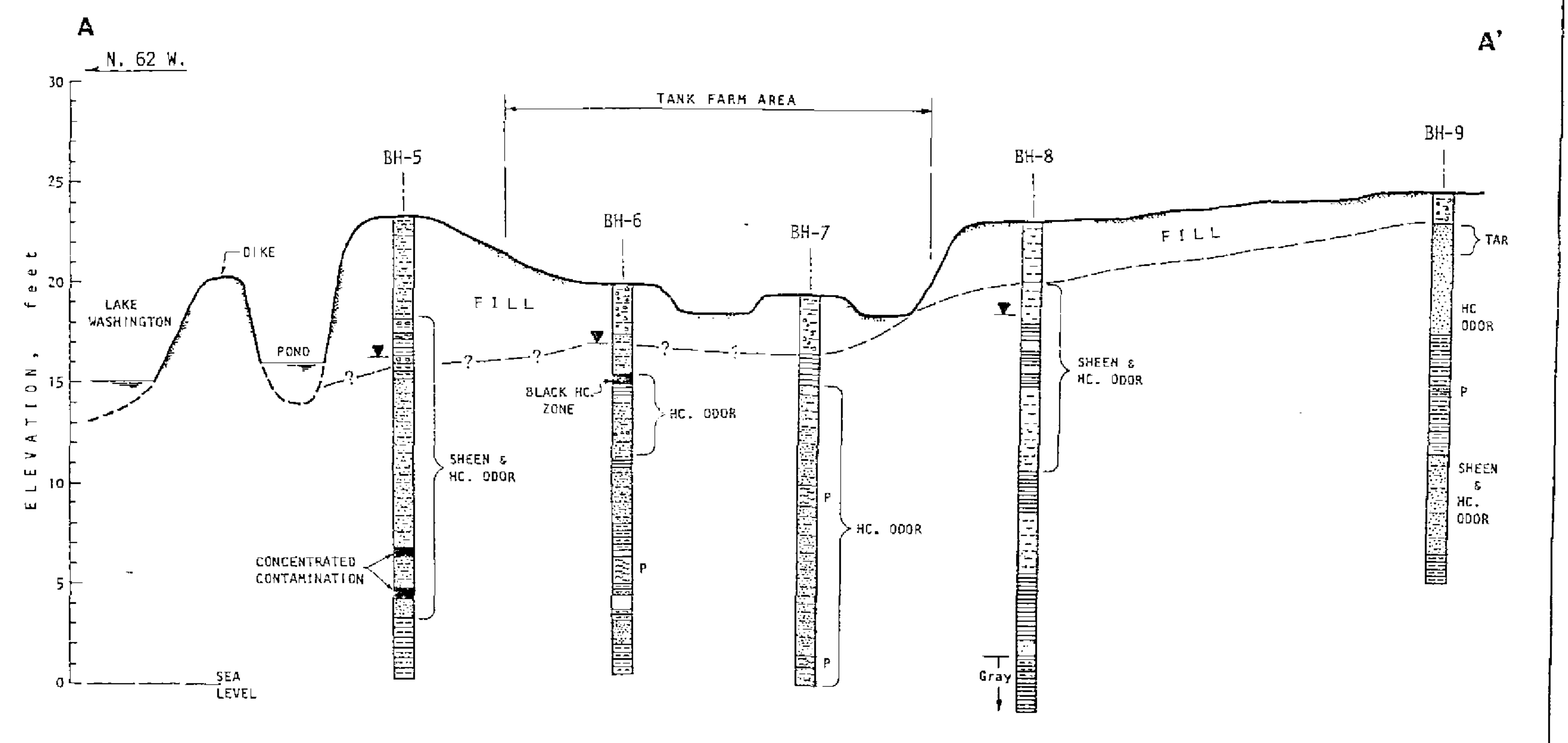
4 SAMPLE LOCATION AND NUMBER

Project No. 90029A	PORT QUENDALL Renton, Washington	CROSS–SECTIONS OF TRENCHES T–1, T–2, AND T–3	Figure 3
Woodward-Clyde Consultants			



TRENCH T-4

Project No. 90029A	PORT QUENDALL Renton, Washington	CROSS–SECTION OF TRENCH T–4	Figure 4
Woodward-Clyde Consultants			



EXPLANATION

- CONTACT LOCATION (APPROXIMATE)
- WATER LEVEL IN BOREHOLE
- CLAY
- SILT
- SAND
- GRAVEL
- PEAT
- BH-7 BORING NUMBER
- HC. HYDROCARBON

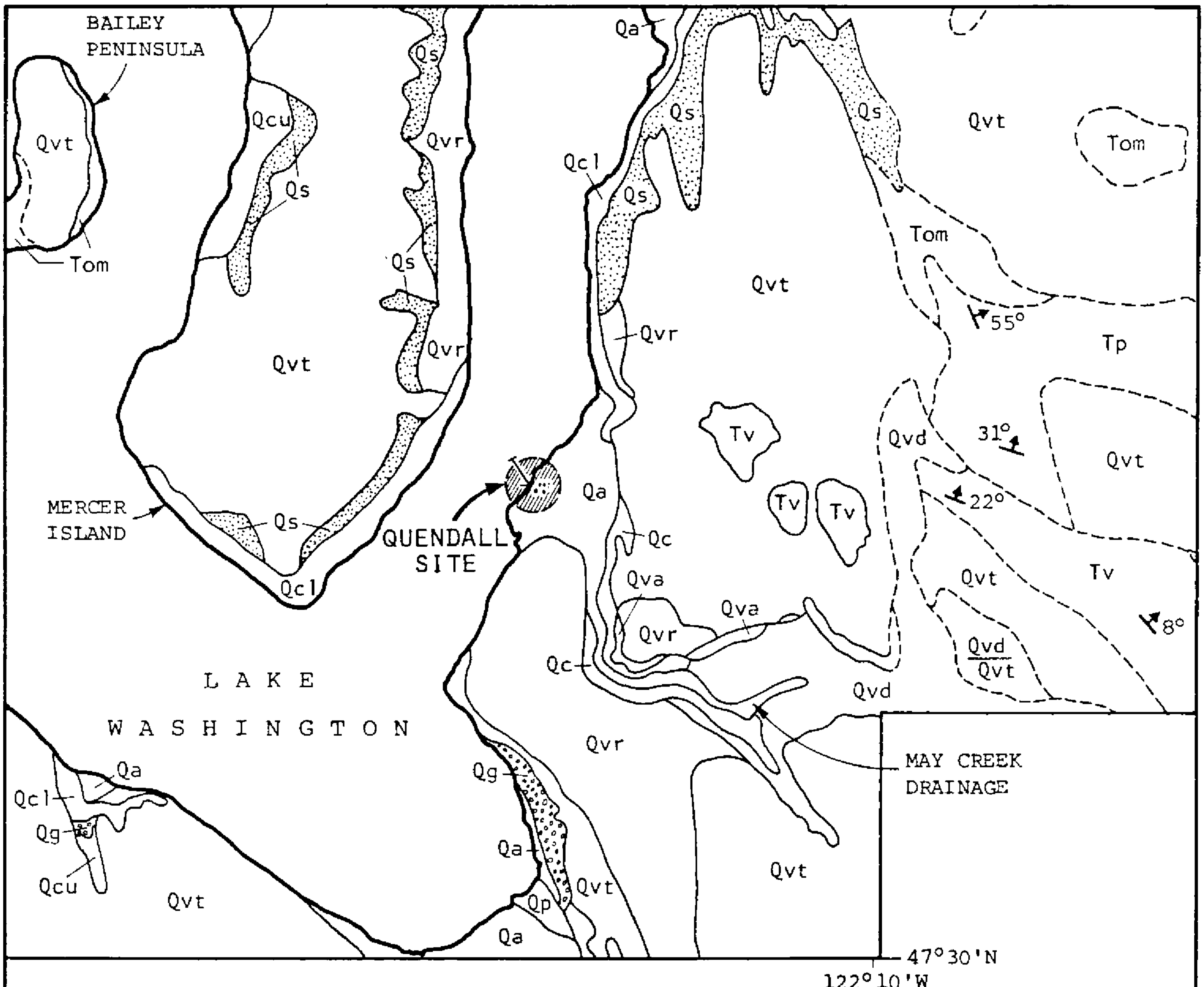
NOTE: Refer to Figure 2 for location of cross-section.

0 50 100 150

Approx. Scale in Feet

Vertical Exaggeration: 10X

Project No. 90029A	PORT QUENDALL Renton, Washington	GEOLOGIC CROSS-SECTION	Figure 5
Woodward-Clyde Consultants			



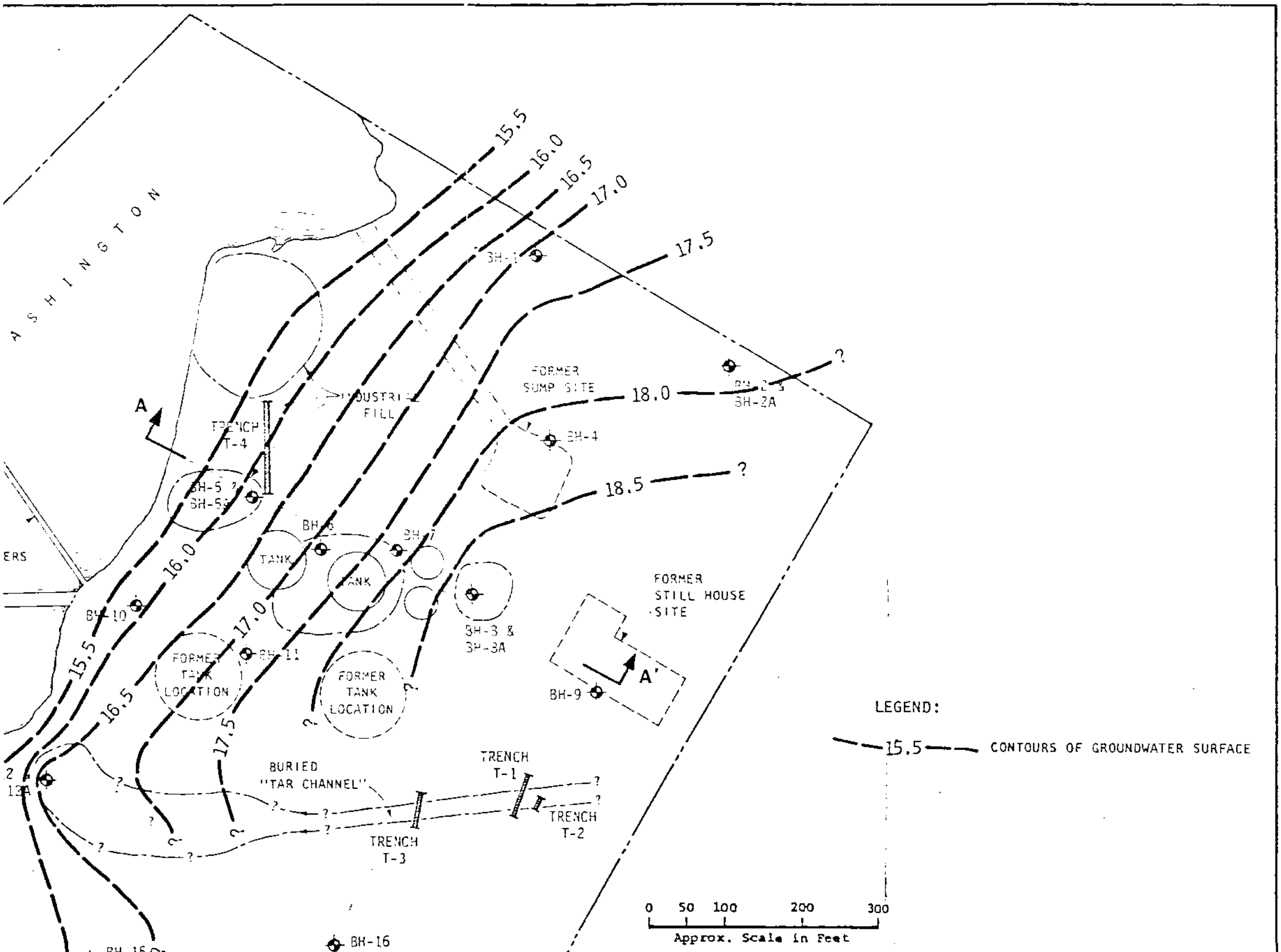
EXPLANATION

RECENT		Qa	SEDIMENTARY DEPOSITS, UNDIFFERENTIATED	Qp	PEAT
PLEISTOCENE	VASHON DRIFT	Qvr	RECESSIONAL STRATIFIED DRIFT	Qvd	DELTA GRAVEL
		Qvt	TILL		
		Qva	ADVANCE STRATIFIED DRIFT		
		Qs	UNNAMED SAND		
		Qcu	UPPER CLAY UNIT		
		Qg	UNNAMED GRAVEL	Qc	CLAY, UNDIFFERENTIATED
		Qcl	LOWER CLAY UNIT		
OLIGOCENE-MIOCENE		Tom	MARINE SEDIMENTARY ROCKS	22°	STRIKE & DIP OF CONSOLIDATED BEDS
EOCENE		Tp	PUGET GROUP		
		Tv	VOLCANIC ROCKS		

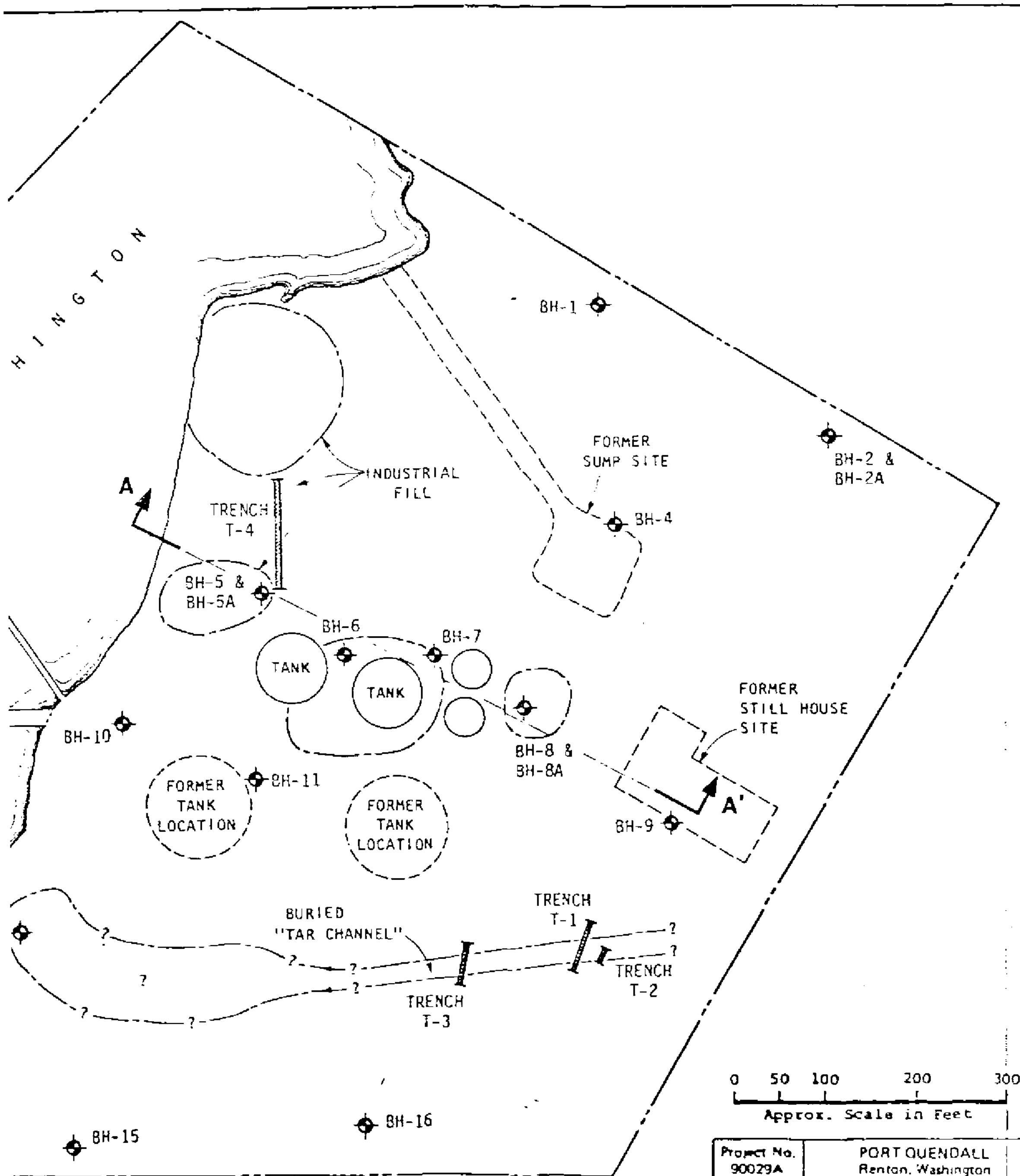
Map after Liesch, Price, & Walters

Scale: 1:48,000

Project No. 90029A	PORT QUENDALL Renton, Washington	SURFICIAL GEOLOGY MAP	Figure 6
Woodward-Clyde Consultants			



Project No. 90029A	PORT GUENDALL Renton, Washington	GROUNDWATER ELEVATION	Figure 7
Woodward-Clyde Consultants			



EXPLANATION

(PAH - %) : SOIL

PAH(ft.) - ppb : WATER

BORING	HIGHEST CONCENTRATION OBESERVED
BH-1	(PAH - 4.8%) PAH(5-19.5') - 115 ppb
BH-2 & BH-2A	(PAH - 0.003%) PAH(5-19') - 5.7 ppb PAH(5-20') - 2640 ppb
BH-4	(PAH - 3.4%)
BH-5 & BH-5A	(PAH - 1.9%) PAH(5-10') - 5210 ppb PAH(13-23') - 4240 ppb
BH-6	(PAH - 1.0%) PAH(8-18') - 930 ppb
BH-7	(PAH - 0.97%)
BH-8 & BH-8A	(PAH - 1.8%) PAH(5-10') - 22,700 ppb PAH(13-23') - 1839 ppb
BH-9	(PAH - 2.2%)
BH-10	(PAH - 0.63%) PAH(5-19.5') - 12.8 ppb
BH-11	(PAH - 0.017%)
BH-12 & BH-12A	(PAH - 0.004%) PAH(5-10') - 745 ppb PAH(13-23') - 6.8 ppb
BH-14	(PAH - 0.022%)
BH-15	(PAH - 0.008%) PAH(5-19.5') - 10.4 ppb
BH-16	(PAH - 1.1%)
TRENCH T-1	(PAH - 1.3%)
TRENCH T-2	(PAH - 0.50%)
TRENCH T-3	(PAH - 1.2%)
TRENCH T-4	(PAH - 1.9%)

Project No. 90029A	PORT QUENDALL Renton, Washington	CHEMICAL CONCENTRATIONS IN SOIL AND WATER	Figure 8

Woodward-Clyde Consultants

APPENDIX A

BORING AND WATER WELL LOGS

Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 1

Date Drilled: May 17, 1983
Type of Boring: 4" Hollow Stem Auger
Hammer Weight:
Remarks:

Surface Elevation: 23.4

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
	1		0.002	FILL Woodchips and Aggregate
				SANDY SILT (ML) Olive-gray, occasional gravel lenses, distinctive HC odor throughout
	2	56	0.93	
5	3	24	4.8	Becomes less sandy
	4	8	0.002	Water ▽ — With some organic debris
	5	14	0.001	SILTY SAND (SM) Medium to fine, 20% silt, frequent peat lenses, some distinctive odor
10				Peat lens
	6	27	0.004	Peat lens
15				
	7	25	0.009	Peat lens
20				BOTTOM OF BORING @ 19.5'

LITHOLOGY

WELL DETAIL: 2-inch I.D. PVC blank; 2-inch I.D. PVC Slotted

Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 2

Date Drilled: May 17, 1983
Type of Boring: 4" Hollow Stem Auger
Hammer Weight:
Remarks:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
				Surface Elevation: 20.8		
	1	52	<	FILL Silt, Gravel and black organic debris		2-inch I.D. PVC blank
	2	33	0.002	SILTY SAND (SM) Olive-gray, damp, occasional lenticular gravels and peat interbeds		
5	3	8	0.003	Water ▽		
	4	44	<			
	5	27	<			
10						2-inch I.D. PVC slotted
				Peat		
	6	10	0.001	Peat		
15						
	7	34	<	Peat		
20				BOTTOM OF BORING @ 19.5'		

Proj. No. 90029A | Woodward-Clyde Consultants | Appendix A-2

Project: PORT QUENDALL, Renton, Washington	Log of Boring No. 2A

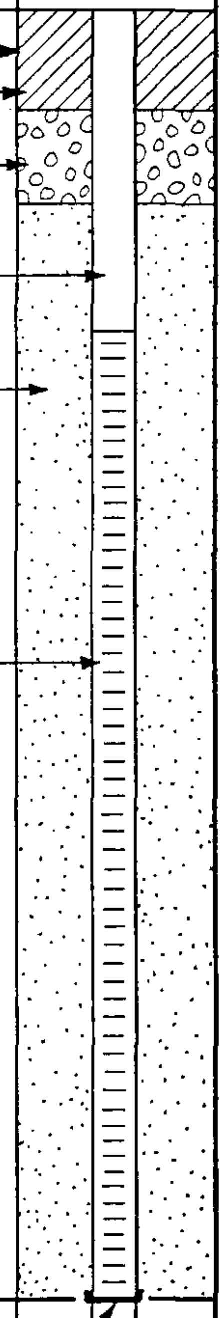
Date Drilled: June 2, 1983

Type of Boring: 6" Hollow Stem Auger

Hammer Weight:

Remarks:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
				Surface Elevation:		
				MONITORING WELL 2A "AS BUILT" DIAGRAM No lithologic log or sampling Installation is monitoring well location 5.7 feet west-southwest of Boring 2		
5						
10						
15						
20				BOTTOM OF BORING @ 20'		



Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 4

Date Drilled: May 18, 1983
Type of Boring: 4" Hollow Stem Auger
Hammer Weight:
Remarks:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
				Surface Elevation:
	1	26	<	FILL Silt with aggregate
5	2		0.002	SANDY SILT (ML) Dark brown, occasional peat lenses } Log ↑ FILL
10	3	2	0.056	CLAYEY SILT (MH) Black, medium-highly plastic, noticeable HC odor and iridescent sheen, some peat
	4	18	0.44	
	5	4	3.4	↓ Iridescent throughout
15				
	6	7	0.75	CLAY (CH) Brown, with occasional peat lenses
20				
	7	2	0.041	BOTTOM OF BORING @ 23'

LITHOLOGY

WELL DETAIL

Bentonite plug 0-23'

Project: PORT QUENDALL Renton, Washington	Log of Boring No. 5

Date Drilled: May 20, 1983
Type of Boring: 6" Hollow Stem Auger
Hammer Weight:
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
	1	10	0.73	FILL Silty Sand (SM), brown, dry, some organic debris/rootlets
	2	10	1.0	
	3	16	0.90	
5	4	20	0.89	Becomes damp, pitch fragments and black fibres, with noticeable HC odor. Water
	5	24	0.89	SILTY CLAY (CH-CL) Olive-gray, medium to high plasticity, occasional black fibres & brick fragments
	6	34	0.006	
10				SILTY SAND (SM) Gray, medium to coarse, distinctive HC odor and iridescent sheen
	7	29	0.006	
15				Concentrated contamination
				Noticeable HC odor and iridescent sheen; some rapid corporation of lighter fractions noted
	8	28	1.9	Concentrated contamination
20				CLAYEY SILT to SANDY SILT (MH-ML) Brown, some odor
	9	12	0.71	BOTTOM OF BORING @ 23'

LITHOLOGY

WELL DETAIL

4-inch I.D. PVC blank (sched 40)

4-inch I.D. PVC slotted

Proj. No. 90029A	Woodward-Clyde Consultants	Appendix A-5

Project: PORT QUENDALL Renton, Washington	Log of Boring No. 5A

Date Drilled: May 20, 1983

Type of Boring: 4" Hollow Stem Auger

Hammer Weight:

Remarks:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
				Surface Elevation:		

MONITORING WELL 5A "AS BUILT" DIAGRAM

No lithologic log or sampling

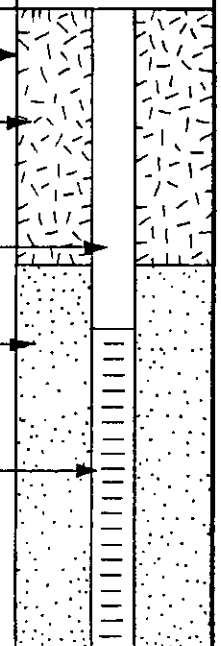
Installation is a shallow monitoring well 4.5 feet north of Boring 5

BENTONITE SEAL

4-INCH I.D. PVC BLANK

SAND PACK

4-INCH I.D. PVC SLOTTED



5

10

BOTTOM OF BORING @ 10'

15

20

Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 6

Date Drilled: May 20, 1983
Type of Boring: 6" Hollow Stem Auger
Hammer Weight:
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
				FILL Silt and aggregate push for drill pad
	1	6	1.0	
5	2	48	0.023	Black HC zone, distinctive odor
	3	7	0.94	SILTY SAND (SM) Gray, medium to coarse, occasional clay lenses, noticeable HC odor
	4	16	0.01	
10				
	5	8	0.002	SILTY CLAY (CH-CL) Brown, occasional peat lenses
15				
	6	3	0.001	
20				BOTTOM OF BORING @ 19.5'

LITHOLOGY

WELL DETAIL:
4-inch I.D. PVC blank
4-inch I.D. PVC slotted

Project: PORT QUENDALL Renton, Washington	Log of Boring No. 7
Date Drilled: May 17, 1983 Type of Boring: 4" Hollow Stem Auger Hammer Weight:	Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
				FILL Silt with gravel, silt pushed for drill pad With gravel		Bentonite plug 0-19.5'
	1	11	0.91	CLAY (CH) Olive-gray, highly plastic, damp		
5	2	2	0.081	SANDY SILT (ML) Dark gray, noticeable HC odor and iridescence		
	3	3	0.74			
	4	1.5	0.97			
10	5	16	0.88	PEAT: With clay, brown, highly plastic, noticeable HC odor		
				SILTY SAND (SM) Dark gray, medium to coarse, noticeable HC odor, occasional peat lenses		
	6	34	0.001			
15						
				Peat interbed		
	7	44	0.008	With HC odor		
20				BOTTOM OF BORING @ 19.5'		

Project: PORT QUENDALL Renton, Washington	Log of Boring No. 8

Date Drilled: May 19, 1983
Type of Boring: 6" Hollow Stem Auger
Hammer Weight:
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
	1	36	0.86	FILL Sandy Silt (ML), dark brown, damp		4-inch I.D. PVC blank
	2	53	0.054			
	3		0.013	SILTY SAND (SM) Olive-gray, medium grained, distinctive HC odor and iridescent sheen		
5	4	19	0.94	CLAY (CH): Light gray, highly plastic		
				SAND (SW): Black, HC odor and sheen		
	5	44	1.2	CLAY (CH): Light gray		
				CLAY (CH): Brown		
	6	30	1.1	SILTY SAND (SM) Water Gray, 30% silt, noticeable HC odor and abundant brown fluid and iridescent sheen		
10						
	7	12	1.8	SILTY CLAY (CH-CL) Light brown, highly plastic, some organic debris (wood)		4-inch I.D. PVC slotted
15				SILTY SAND (SM) Brownish gray, 30% sand		
	8	19	1.3	SILTY CLAY (CH-CL) Dark brown, occasional sand lenses		
20						
22				Becomes gray		
24	9	27	0.042	BOTTOM OF BORING @ 24.5'		

Proj. No. 90029A	Woodward-Clyde Consultants	Appendix A-9

Project: PORT QUENDALL Renton, Washington	Log of Boring No. 8A

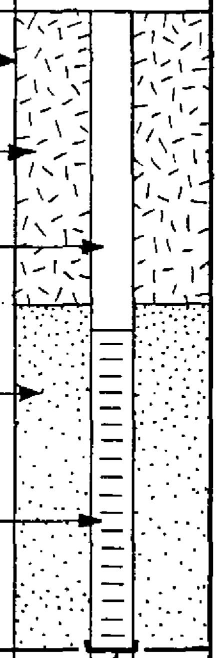
Date Drilled: May 19, 1983

Type of Boring: 6" Hollow Stem Auger

Hammer Weight:

Remarks:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
				Surface Elevation:		
				MONITORING WELL 8A "AS BUILT" DIAGRAM No lithologic log or sampling Installation is shallow monitoring well 6 feet south of Boring 8		
5						
10				BOTTOM OF BORING @ 10'		
15						
20						



Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 9

Date Drilled: May 16, 1983

Type of Boring: 4" Hollow Stem Auger

Hammer Weight:

Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
	1		0.005	FILL Silt, with some gravels
	2		1.7	TAR: Black, distinctive HC odor, with occasional cement fragments
	3		2.2	SAND: Black stain with odor — Wood
5				
	4	10	1.3	
	5	4	0.014	CLAYEY SILT (MH) Olive-gray, damp, soft, distinctive odor
	6	9	1.0	
10				Brown peat
	7	25	0.03	SILTY SAND (SM) Medium to fine, poorly sorted, distinctive iridescent sheen and odor in sand
15				
	8	28	<	CLAYEY SILT (MH) Olive-gray, slight odor
20				BOTTOM OF BORING @ 19.5

LITHOLOGY

WELL DETAIL

Bentonite plug 0-19.5'

Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 10

Date Drilled: May 18, 1983
Type of Boring: 6" Hollow Stem Auger
Hammer Weight:
Remarks:

Surface Elevation:

Depth, Ft	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
	1	20	0.63	FILL Silty Sand (SM), olive-brown, 10% silt, occasional organic debris and gravels
	2	28	0.009	
	3	19	0.002	Water ▽
5	4	22	0.002	Becomes gray, with slight HC odor
	5	11	0.002	
10				
	6	9	<	CLAYEY SILT (MH) Brown, 20-30% clay, highly plastic, damp
15				
	7	15	<	SILTY SAND (SM)
20				BOTTOM OF BORING @ 19.5'

LITHOLOGY

WELL DETAIL

4-inch I.D. PVC blank

4-inch I.D. PVC slotted

Proj. No. 90029A

Woodward-Clyde Consultants

Appendix A-12

Project: PORT QUENDALL Renton, Washington	# Log of Boring No. 11

Date Drilled: May 18, 1983
Type of Boring: 4" Hollow Stem Auger
Hammer Weight:
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
	1	14	0.007	FILL Gravel and Sand		Bentonite plug 0-19.5'
	2	66	0.017	SANDY SILT (ML) Dark brown, 20-40% sand, some clay, occasional lenticular gravels and peat		
	3	36	0.002			
5	4	6	0.002	→ Brown peat		
	5	13	0.003	CLAYEY SILT (MH) Gray, soft, dry, some organic debris, and peat interbeds		
	6	25	0.003	SILTY SAND (SM) Dark gray, 30% silt, no odor (occasional peat lenses)		
10						
				→ Thin (0.2') peat lens		
	7	16	<	→ Thin (0.2') peat lens		
15						
				→ Thin (0.2') peat lens		
	8	27	0.01			
20				BOTTOM OF BORING @ 19.5'		

Project: PORT QUENDALL Renton, Washington	Log of Boring No. 12

Date Drilled: May 17, 1983

Type of Boring: 4" Hollow Stem Auger

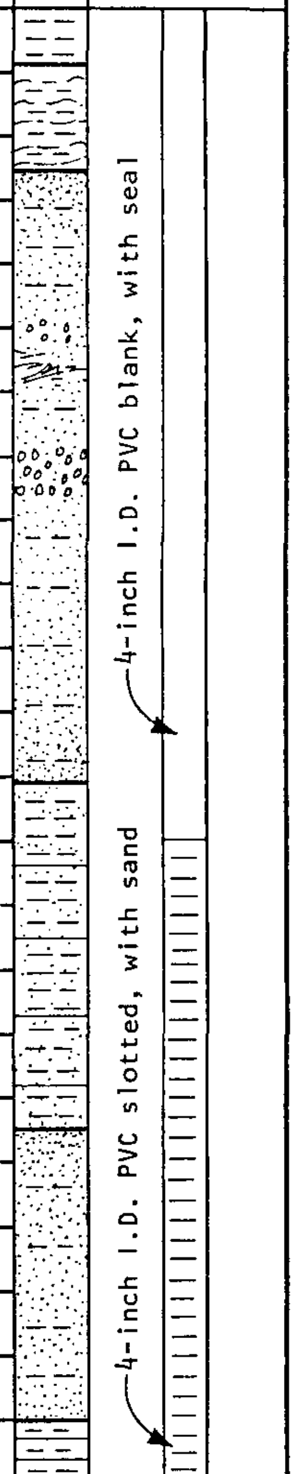
Hammer Weight:

Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
				FILL: Silt, dark brown
				FILL: Silt, with organics
	1	29	0.004	
				SILTY SAND (SM) Gray, medium to fine, occasional gravel lenses, and organic
	2	20	<	
5	3	53	0.001	▽ Water
	4	40	0.003	
10				
				SANDY SILT / CLAYEY SILT (ML-MH) Brown, damp, soft, abundant organic debris
	5	19	0.001	
15				
				SILTY SAND (SM) Gray, 40% silt, abundant organic debris
	6	4	0.003	
20				
				SILTY CLAY (CH-CL) Brown, damp, medium to highly plastic
	7	2	<	BOTTOM OF BORING @ 23'

LITHOLOGY / WELL DETAIL



Project: PORT QUENDALL Renton, Washington	Log of Boring No. **12A**

Date Drilled:

Type of Boring: 6" Hollow Stem Auger

Hammer Weight:

Remarks:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
				Surface Elevation:		

MONITORING WELL 12A "AS BUILT" DIAGRAM

No lithologic log or sampling

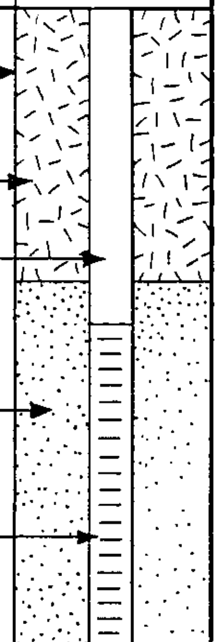
Installation is shallow monitoring well 6.5 feet west of Boring 12

BENTONITE SEAL

4-INCH I.D. PVC BLANK

SAND PACK

4-INCH I.D. PVC SLOTTED



5

10

BOTTOM OF BORING @ 10'

15

20

Project: PORT QUENDALL Renton, Washington	Log of Boring No. 14
Date Drilled: May 18, 1983 Type of Boring: 4" Hollow Stem Auger Hammer Weight:	Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION	LITHOLOGY	WELL DETAIL
	1		0.022	FILL Silt and Gravel Aggregate, slight odor, occasional pitch fragments and wood		Bentonite plug 0-19.5'
	2	43	0.007	Pitch fragments		
5	3	26	0.007	Water ▽		
	4	28	<	SILTY SAND (SM) Dark gray, medium, saturated, occasional thin gravel interbeds		
	5	20	0.009			
10				Grades to finer sand		
	6	7	<	Becomes fine sand		
15						
				Coarse		
	7	24	<	PEAT With clay, brown, highly plastic		
20				BOTTOM OF BORING @ 19.5'		

Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 15

Date Drilled: May 17, 1983

Type of Boring: 4" Hollow Stem Auger

Hammer Weight:

Remarks:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
				Surface Elevation:
	1	58	0.004	FILL: Silt, dark brown
				SAND (SW) Medium to fine, occasional gravel and clay lenses, slight HC odor
	2	32	0.008	
				SANDY SILT (ML) Greenish gray, some clay (10-20%) occasional organics/peat fragments
5	3	22	0.002	
	4	44	<	SILTY SAND (SP-SM) 30% silt, medium to coarse sand, some HC odor throughout
	5	43	<	
10				
	6	19	0.002	PEAT: With clay, brown, highly plastic
15				SILTY SAND (SP-SM) Slight odor
	7	9	0.001	
20				BOTTOM OF BORING @ 19.5'

LITHOLOGY

WELL DETAIL

2-inch I.D. PVC blank, with bentonite seal

2-inch I.D. PVC slotted, with sand pack

Project: PORT QUENDALL
Renton, Washington

Log of Boring No. 16

Date Drilled: May 16, 1983

Type of Boring: 4" Hollow Stem Auger

Hammer Weight:

Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	PAH concentration (%)	MATERIAL DESCRIPTION
	1	79	0.004	FILL
	2	54	1.1	SAND (SW) Medium, occasional gravel lenses, noticeable HC odor and black stain
	3	19	0.001	SAND (SP) Medium to coarse, occasional gravel lenses, no stain or odor
5	4	8	<	Water ▽
	5	32	<	CLAYEY SILT (MH) Olive-gray, medium plasticity, occasional organics, (brownish peat lenses)
	6	19	<	
10	7	32	<	Peat lens
	8	29	<	Clayey silt lens
15				
				SAND (SW) Dark gray, some silt
	9	18	<	CLAY (CH): Stiff
20				BOTTOM OF BORING @ 19.5'

LITHOLOGY

WELL DETAIL

Bentonite plug 0-19.5'

APPENDIX B

FIELD WATER SAMPLING AND WATER LEVEL DATA SHEETS

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH-1	6-8-83	12:10	⊖	5.8	—	—	—	—	Start Pump
"	"	12:20	13.7	—	15	6.5	612umhos	1	pumping
"	"	12:26	27.5	—	15	6.8	589 "	2	" "
"	"	12:31	41.2	—	15	6.9	579 "	3	" "
"	"	12:36	55	—	15	6.9	549 "	4	" "
"	"	12:40:45	⊖	17.22	—	—	—	—	Stop Pump
"	"	12:45:30	—	6.74	—	—	—	—	Recovery
"	"	12:48	—	6.52	—	—	—	—	" "
"	"	12:50	—	6.40	—	—	—	—	" "
"	"	12:54:10	—	6.31	—	—	—	—	" "
"	"	12:59	—	6.22	—	—	—	—	" "
"	"	13:02	—	6.15	—	—	—	—	BEGIN HAND BAILING
"	"	13:46	—	—	—	—	—	—	END HAND BAILING

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH-2	6-8-83	15:13	0	7.4	—	—	—	—	START PUMP
"	"	15:15	13.7	—	15	6.6	785 umhos	1	Pumping
"	"	15:23:30	27.5	—	15	6.8	753 "	2	" "
"	"	15:31:15	41.2	—	15	6.8	743 "	3	" "
"	"	15:38:30	55	—	15	6.7	725 "	4	" "
"	"	15:42:15	—	8.80	—	—	—	—	STOP PUMP
"	"	15:45	—	8.41	—	—	—	—	Recovery
"	"	15:45:30	—	8.35	—	—	—	—	" "
"	"	15:46	—	8.25	—	—	—	—	" "
"	"	15:47	—	8.11	—	—	—	—	" "
"	"	15:48	—	7.95	—	—	—	—	" "
"	"	15:49	—	7.85	—	—	—	—	" "
"	"	16:03	—	—	15	6.9	710 "	5	BEGIN HAND BAILING
"	"	16:30	—	—	15	6.9	669 "	6	END HAND BAILING

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH2A	6-20-83	9:10	—	7.17	12.5	5.9	472umhos	1	START Pump
"	"	9:23	13.75	10.16	15	6.3	412 "	2	pumping
"	"	9:37	27.5	10.24	15	6.3	420 "	3	" "
"	"	9:55	41.25	10.25	15	6.3	438 "	4	" "
"	"	10:12	55	10.26	15	6.0	447 "	5	" "
"	"	10:26	68.17	10.56	15	6.1	450 "	6	" "
"	"	10:38	82.5	10.71	15	5.7	444 "	7	" "
"	"	10:53	96.2	10.65	15	6.2	462 "	8	" "
"	"	11:04	110	11.68	15.5	6.1	454 "	9	" "
"	"	11:17	123.7	11.46	15	6.1	467 "	10	" "
"	"	11:29	137.5	11.61	15	6.1	453 "	11	" "
"	"	11.40	151.2	11.70	15	5.9	467 "	12	" "
"	"	11.53	165.0	11.63	15	5.7	472 "	13	" "
"	"	11:56	—	11.64	—	—	—	—	Stop Pump
"	"	11:56:30	—	10.91	—	—	—	—	Recovery
"	"	11:57	—	10.3	—	—	—	—	" "
"	"	11:57:30	—	9.88	—	—	—	—	" "
"	"	11:58	—	9:54	—	—	—	—	" "
"	"	11:58:30	—	9:30	—	—	—	—	" "
"	"	11:59	—	9.09	—	—	—	—	" "
"	"	12:00	—	8.72	—	—	—	—	" "
"	"	12:01	—	8.49	—	—	—	—	" "
"	"	12:03	—	8.19	—	—	—	—	" "
"	"	12:05	—	8.02	—	—	—	—	" "
"	"	12:08	—	7.88	—	—	—	—	" "

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
3H-5	6-17-83	12:48	—	9.36	13	5.9	705umhos	1	START Pump
"	"	13:02	13.75	10.29	15	5.8	782umhos	2	Pumping
"	"	13:16	27.5	10.54	15.5	5.7	303 "	3	" "
"	"	13:29	41.25	10.64	15	5.7	902 "	4	" "
"	"	13:38	55.0	10.81	15	5.7	876 "	5	" "
"	"	13:47	68.7	11.00	15	5.8	847 "	6	" "
"	"	13:58	82.5	11.05	15	5.7	844 "	7	" "
"	"	14:08	96.25	11.20	14	5.7	839 "	8	" "
"	"	14:16	110	11.36	14	5.7	837 "	9	" "
"	"	14:25	123.7	11.25	14	5.7	841 "	10	" "
"	"	14:34	137.5	11.28	14	5.8	836 "	11	" "
"	"	14:44	151.2	11.22	14	5.8	717 "	12	" "
"	"	14:53	165	11.3	14	5.8	852	13	" "
"	"	14:56	—	—	—	—	—	—	STOP Pump
"	"	14:56:30	—	10.33	—	—	—	—	Recovering
"	"	14:57	—	10.11	—	—	—	—	" "
"	"	14:57:30	—	9.96	—	—	—	—	" "
"	"	14:58	—	9.88	—	—	—	—	" "
"	"	14:59	—	9.84	—	—	—	—	" "
"	"	15:00	—	9.78	—	—	—	—	" "
"	"	15:02	—	9.75	—	—	—	—	" "

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH-5A	6-20-83	14:40	—	7.10	18	5.6	310umhos	1	Start Pump
"	"	14:49	2.5	8.78	28	5.6	354 "	2	Pumping
"	"	15:14	5.0	9.18	39	5.5	516 "	3	Note low rate [illegible] pump.
"	"	15:15	—	9.8	—	—	—	—	Stop Pump
"	"	15:15:30	—	9.61	—	—	—	—	Recovery
"	"	15:16	—	9.57	—	—	—	—	" "
"	"	15:16:30	—	9.52	—	—	—	—	" "
"	"	15:17	—	9.5	—	—	—	—	" "
"	"	15:19	—	9.34	—	—	—	—	" "
"	"	15:25	—	9.13	—	—	—	—	" "
"	"	15:30	—	9.03	—	—	—	—	" "
"	"	15:40	—	—	—	—	—	—	Begin Bailing

* Well produced an average of 0.1 to 0.28 GPM which heated pump & would require excessive time to achieve desired cumulative volume. Sampling followed recovery period. Black tar residue on bailer suggests that reduced productivity may be the result of screen blockage in the well by mobile tar.

D. Spencer

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH-6	6-17-82	16:01	—	4.67	14	5.5	305 umhos	1	START PUMP
"	"	16:08	13.75	6.82	14	5.4	336 "	2	PUMPING
"	"	16:15	27.5	6.98	14	5.4	344 "	3	" "
"	"	16:21	41.25	7.93	14	5.5	337 "	4	" "
"	"	16:26	55.0	8.13	14	5.5	339 "	5	" "
"	"	16:31	68.17	8.10	14	5.4	344 "	6	" "
"	"	16:36	82.5	8.14	14	5.4	342 "	7	" "
"	"	16:40	96.2	8.18	14	5.4	339 "	8	" "
"	"	16:45	110	8.17	14	5.7	341 "	9	" "
"	"	16:49	123.7	8.43	14	5.7	340 "	10	" "
"	"	16:53	137.5	8.62	14	5.7	342 "	11	" "
"	"	16:58	151.2	8.64	14	5.6	340 "	12	" "
"	"	17:02	165	8.68	14	5.6	338 "	13	" "
"	"	17:04	—	8.70	—	—	—	—	Stop Pump
"	"	17:04:30	—	8.10	—	—	—	—	Recovery
"	"	17:05	—	6.54	—	—	—	—	" "
"	"	17:05:30	—	6.27	—	—	—	—	" "
"	"	17:06	—	6.09	—	—	—	—	" "
"	"	17:07	—	5.93	—	—	—	—	" "
"	"	17:08	—	5.83	—	—	—	—	" "
"	"	17:10	—	5.67	—	—	—	—	" "
"	"	17:12	—	5.56	—	—	—	—	" "

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH-18	6-16-83	15:38	—	6.37	15	6.3	402 umhos	1	START Pump
"	"	15:52	13:75	11.88	15	6.0	501 "	2	Pumping
"	"	16:10	27.5	12.92	15	6.0	515 "	3	" "
"	"	16:24	41.25	13.17	15	5.8	520 "	4	" "
"	"	16:42	55	13.18	15	5.8	527 "	5	" "
"	"	16:55	68.7	16.38	15	5.9	512 "	6	" "
"	"	17.05	82.5	17.63	15	5.9	510 "	7	" "
"	"	17.17	96.3	18.36	15	5.8	516 "	8	IRIDESCENT SHEEN + ODOR
"	"	17:27	110	18.47	15	5.8	520 "	9	" "
"	"	17.40	123.7	19.09	15	5.8	519 "	10	" "
"	"	18:02	137.5	14.81	15	5.8	539 "	11	" "
"	"	18:21	151.2	14.33	15	5.8	538 "	12	" "
"	"	18:35	165	16.8	15	5.8	525 "	13	" "
"	"	18:38	—	17.0	—	—	—	—	Stop pump
"	"	1838 30	—	16.35	—	—	—	—	Recovery
"	"	1839	—	15.75	—	—	—	—	" "
"	"	1839 30	—	—	—	—	—	—	" "
"	"	1840	—	—	—	—	—	—	" "
"	"	1840 30	—	14.60	—	—	—	—	" "
"	"	1841 30	—	14.25	—	—	—	—	" "
"	"	1842	—	13.79	—	—	—	—	" "
"	"	1843	—	13.05	—	—	—	—	" "
"	"	1844	—	12.56	—	—	—	—	" "
"	"	1846	—	11.56	—	—	—	—	" "
"	"	1850	—	10.4	—	—	—	—	" "

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH 8A	6-17-83	9:37	—	4.54	15.0	5.9	647 umhos	1	START PUMP
"	" "	9:47	—	10.00	—	—	—	—	WELL DRY- STOPPED PUMP
"	" "	1007	—	4.82	—	—	—	—	START PUMP
		11:0[illegible]	11.4 GAL	6.42	—	6.2	967 "	2	
"	" "	11:0[illegible]	22.8 GAL	—	—	—	—	—	STOP PUMP
"	" "	11:08	—	3.85	—	—	—	—	Recovery
"	" "	11:08:30	—	8.48	—	—	—	—	"
"	" "	11:09	—	8.18	—	—	—	—	" "
"	" "	11:09:30	—	7.93	—	—	—	—	" "
"	" "	11:10	—	7.70	—	—	—	—	" "
"	" "	11:11	—	7.32	—	—	—	—	" "
"	" "	11:12	—	7.11	—	—	—	—	" "
"	" "	11:13	—	6.98	—	—	—	—	" "
"	" "	11:15	—	6.74	—	—	—	—	" "
"	" "	11:17	—	6.48	—	—	—	—	" "
"	" "	11:20	—	6.12	—	—	—	—	" "
"	" "	11:40	—	—	13	6.2	692 "	3	BAILING & SAMPLING

* NOTE: 22.8 GAL PUMPED plus one well volume bailed prior to sampling For Lab, well production low, time & budget dictated that sampling be done on schedule.

D. Spencer

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
RH-1b	6-15-83	9:15	0	6.65	13.0	5.6	548umhos	1	Start Pump
"	"	9:19	13.75	10.35	13.5	5.7	512 "	2	Pumping
"	"	9:26	27.5	10.95	13.5	5.7	512 "	3	" "
"	"	9:31	41.25	11.13	13.5	5.7	512 "	4	" "
"	"	9:38	55	11.32	13.5	5.6	513 "	5	" "
"	"	9:43	68.7	11.48	13.5	5.7	507 "	6	" "
"	"	9:51	82.5	11.62	14.0	5.7	505 "	7	" "
"	"	9:58	96.25	11.75	14.0	5.7	510 "	8	" "
"	"	10.02	110	11.85	14.0	5.7	506 "	9	" "
"	"	10:12	123.7	11.96	14.0	5.6	499 "	10	" "
"	"	10:15	137.5	12.02	14.0	5.6	510 "	11	" "
"	"	10:22	151.2	12.18	14.0	5.6	501 "	12	" "
"	"	10:27	165	12.22	14.0	5.6	502 "	13	" "
"	"	10:28	—	10.35	—	—	—	—	Stop Pump
"	"	10:29	—	10.35	—	—	—	—	Recovery
"	"	10:29:30	—	9.58	—	—	—	—	" "
"	"	10:30:00	—	9.17	—	—	—	—	" "
"	"	10:30:30	—	8.80	—	—	—	—	" "
"	"	10:31	—	8.54	—	—	—	—	" "
"	"	10:31:30	—	8.32	—	—	—	—	" "
"	"	10:32	—	8.18	—	—	—	—	" "
"	"	10:33	—	7.94	—	—	—	—	" "
"	"	10:34	—	7.8	—	—	—	—	" "
"	"	10:35	—	—	—	—	—	—	BEGIN HAND BAILING
"	"	11:00	—	—	—	—	—	—	END HAND BAILING

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH 12	6-20-83	16:18	—	7.50	14	5.9	358 umhos	1	BEGIN BAILING
"	"	16:41	—	—	14	6.8	343 "	2	END BAILING
"	"	16:5[illegible]	—	10.82	—	—	—	—	Recovery
"	"	16:50:30	—	10.65	—	—	—	—	" "
"	"	[illegible]	—	10.53	—	—	—	—	" "
"	"	16:52	—	10.28	—	—	—	—	" "
"	"	16:53	—	10.09	—	—	—	—	" "
"	"	16:55	—	9.70	—	—	—	—	" "
"	"	17:00	—	9.09	—	—	—	—	" "
"	"	17:05	—	8.65	14	6.9	341 "	3	" "

* WELL WAS PUMPED ON 6-15-83 with insufficient production to sustain pump. Subsequent bailing on 6-20-83 of 3 volumes preceded data which appear above.

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH12A	6-27-83	1450	—	5.11	16°		899 umhos	1	Bailed

Bailed for samples / well could not produce adequately for pump test.

D Spencer

FIELD WATER SAMPLING DATA SHEET
Port Quendall- Project 90029 A
Don W. Spencer- Project Geologist

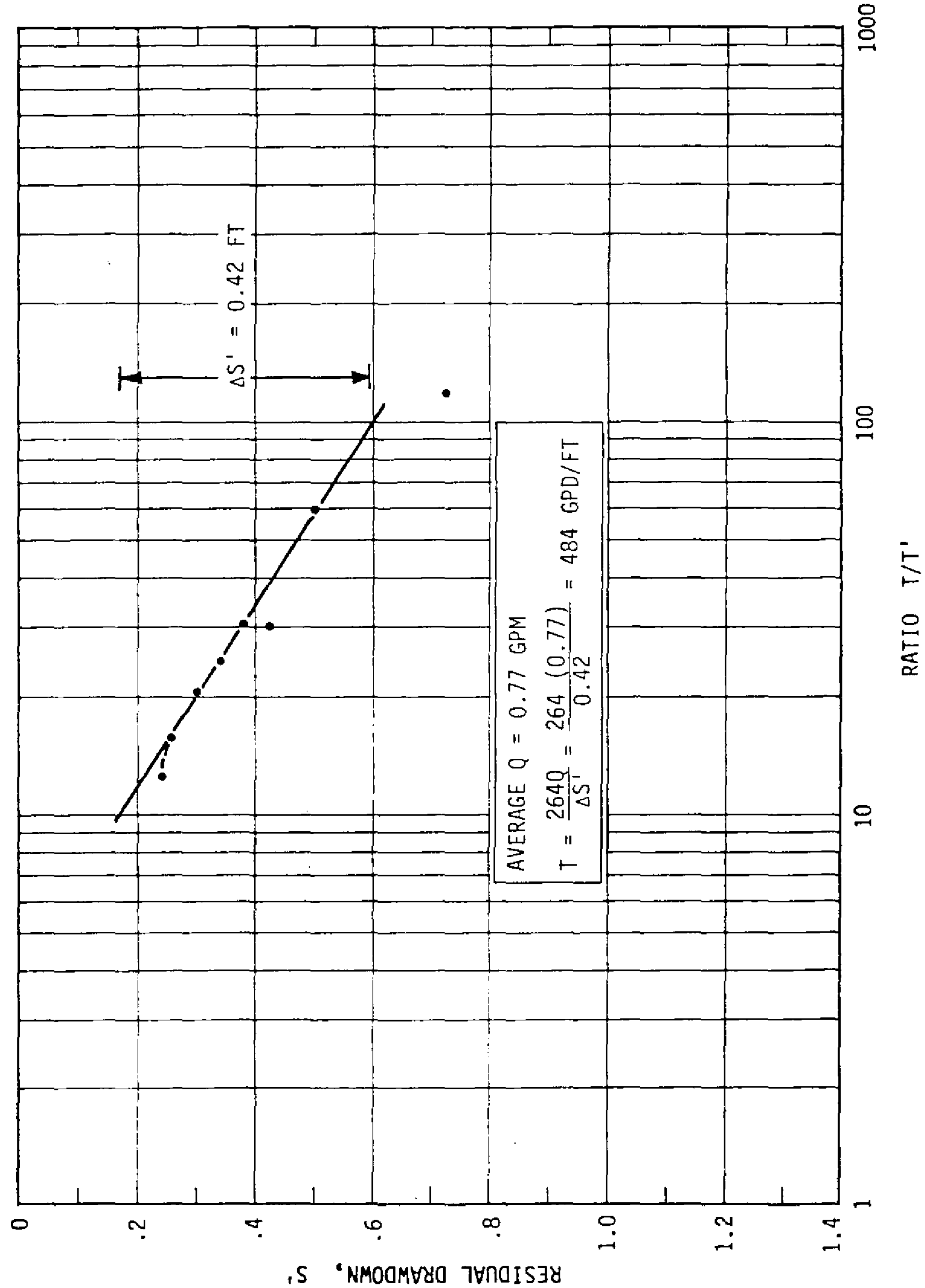
WELL	DATE	TIME	VOLUME OF DISCHARGE	DEPTH TO WATER	TEMP (°C)	pH	Cs	SAMPLE #	REMARKS
BH-15	6-15-83	12:43	0	5.50	15	6.7	429umhos	1	START Pump
"	"	13:05	13.75	—	18	6.3	437 "	2	Pumping
"	"	13:22	27.5	—	17	6.0	413 "	3	" "
"	"	13:38	41.2	—	17	5.7	415 "	4	" "
"	"	13:42	0	—	—	—	—	—	STOP Pump
"	"	13:42:30	—	6.22	—	—	—	—	Recovery
"	"	13:43	—	6.0	—	—	—	—	" "
"	"	13:43:30	—	5.92	—	—	—	—	" "
"	"	13:44	—	5.88	—	—	—	—	" "
"	"	13:44:30	—	5.84	—	—	—	—	" "
"	"	13:45	—	5.80	—	—	—	—	" "
"	"	13:46	—	5.76	—	—	—	—	" "
"	"	13:47	—	5.74	—	—	—	—	" "
"	"	13:49	—	—	—	—	—	—	BEGIN HAND BAILING
"	"	14:00	—	—	—	—	—	—	END HAND BAILING

WATER LEVEL DATA SHEET

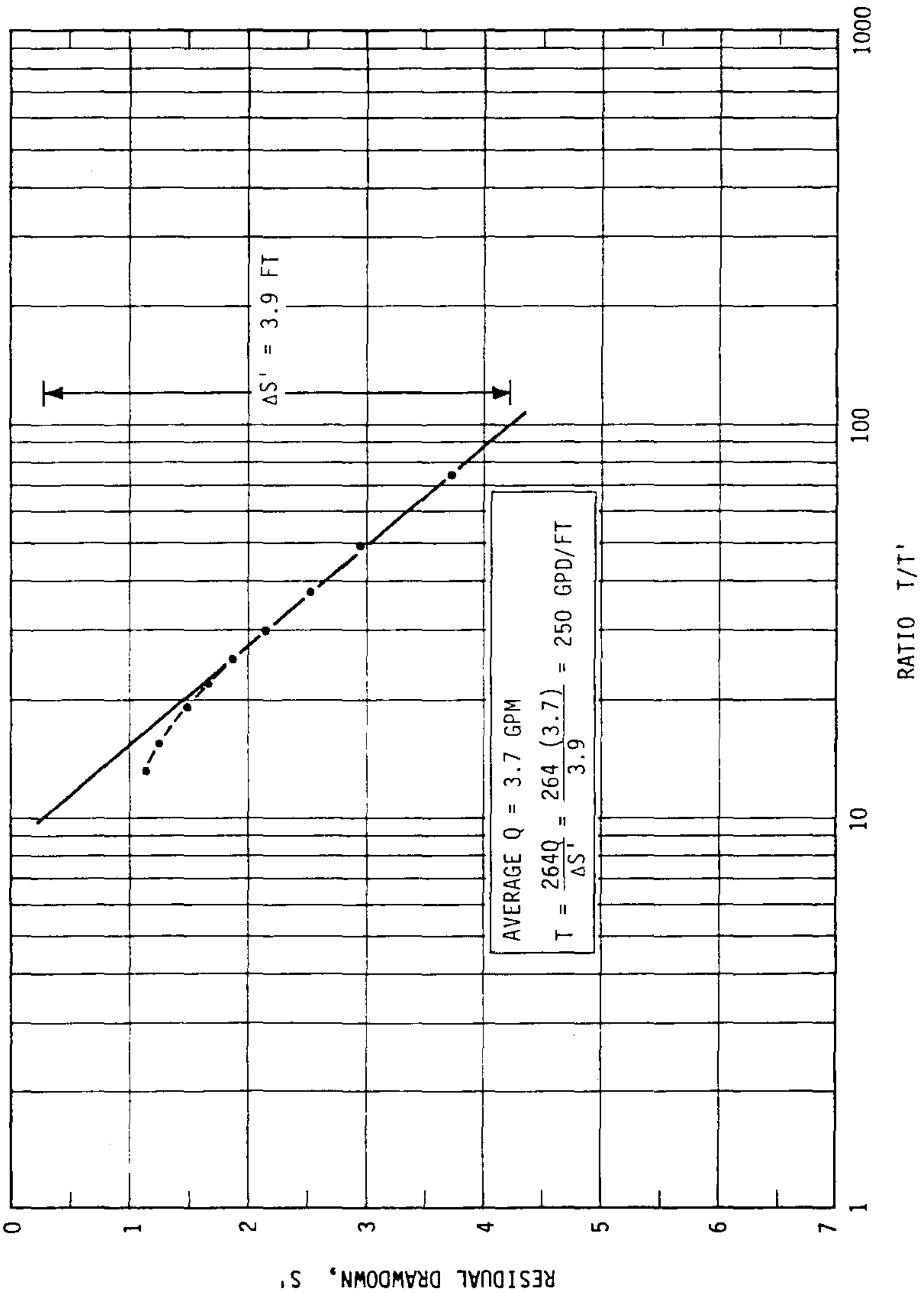
WELL	DATE	TIME	MEASURING POINT (MP)	MP ELEVATION (FT)	DEPTH TO WATER (FT)	STATIC WATER ELEVATION (FT)
BH-1	6-27-83	14:15	top of casing	23.42	6.11	17.31
BH-2	6-27-83	13:59	top of casing	25.47	7.53	17.94
BH-2A	6-27-83	14:07	top of casing	25.06	7.16	17.90
BH-5	6-27-83	12:50	top of casing	25.64	9.51	16.13
BH-5A	6-27-83	13:02	top of casing	24.28	7.81	16.47
BH-6	6-27-83	12:44	top of casing	21.85	4.84	17.01
BH-8	6-27-83	13:09	top of casing	25.12	6.40	18.72
BH-8A	6-27-83	13:12	top of casing	23.64	4.72	18.92
BH-10	6-27-83	12:10	top of casing	22.50	6.59	15.91
BH-12	6-27-83	12:19	top of casing	24.39	7.56	16.83
BH-12A	6-27-83	12:23	top of casing	21.41	5.11	16.30
BH-15	6-27-83	12:31	top of casing	21.70	5.55	16.15

APPENDIX C

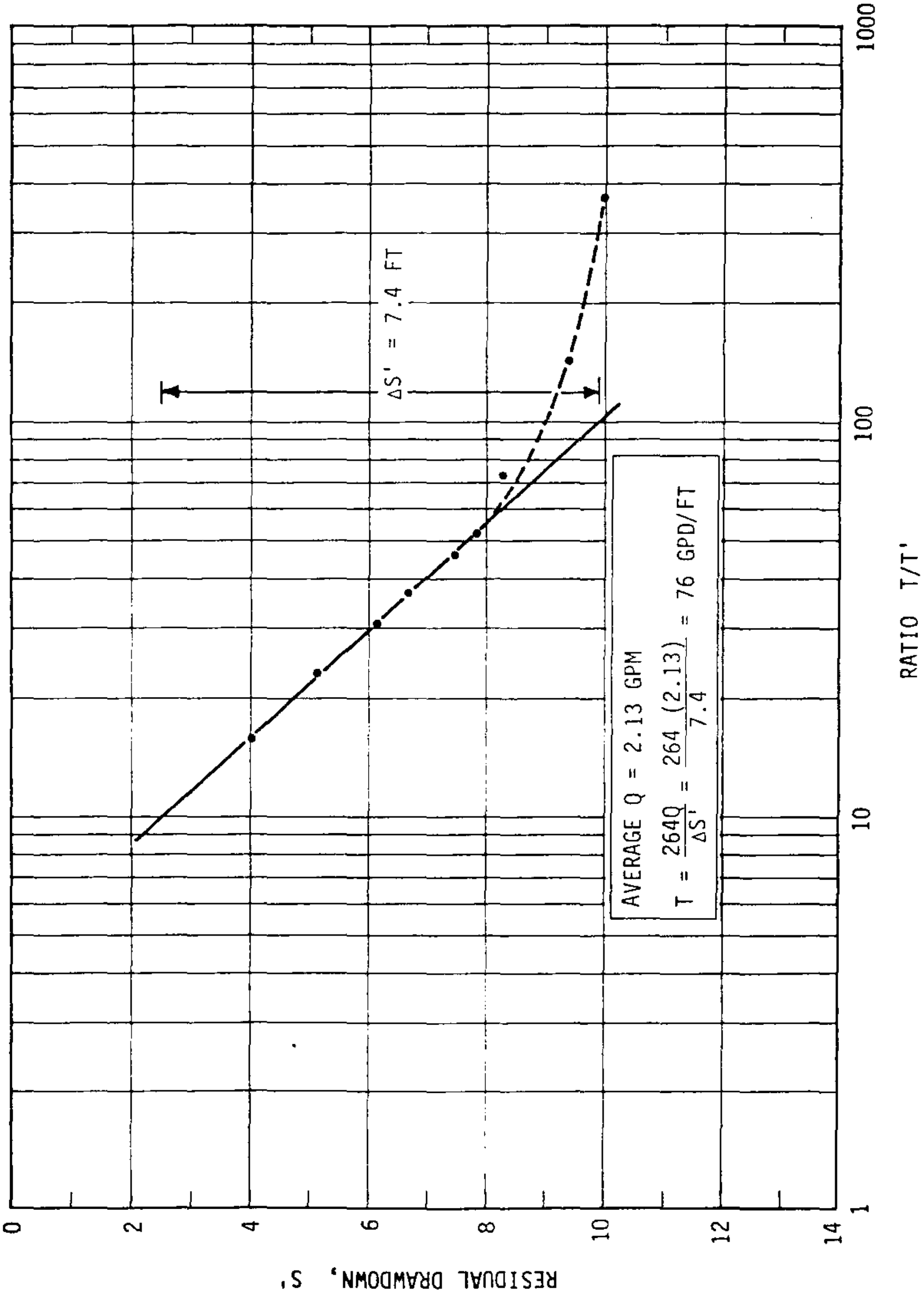
TRANSMISSIBILITY CALCULATIONS FOR SELECTED WELLS



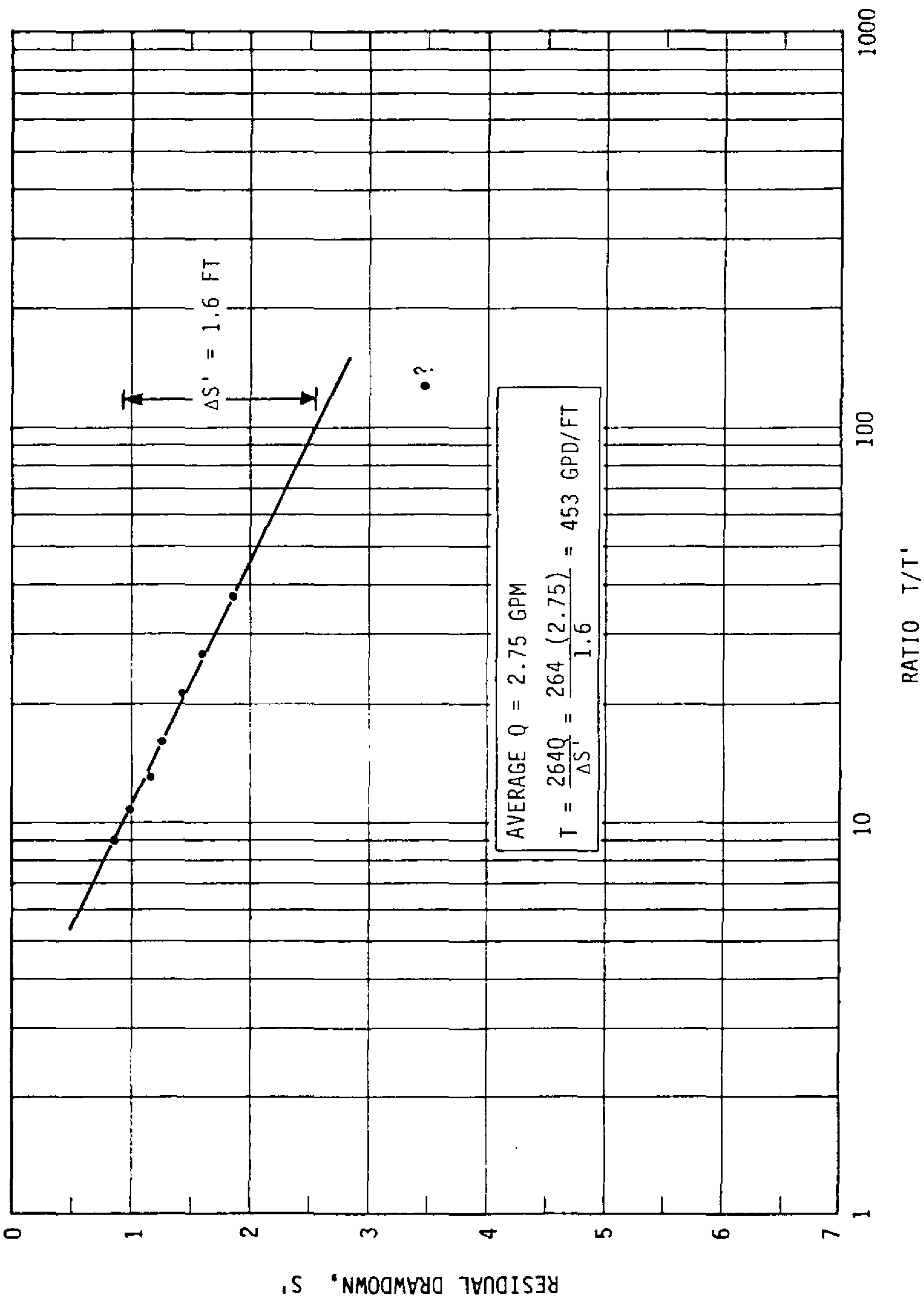
Project No. 90029A	PORT QUENDALL Renton, Washington	DRAWDOWN CURVE AND TRANSMISSIVITY CALCULATION FOR BORING 15	Appendix
Woodward-Clyde Consultants			



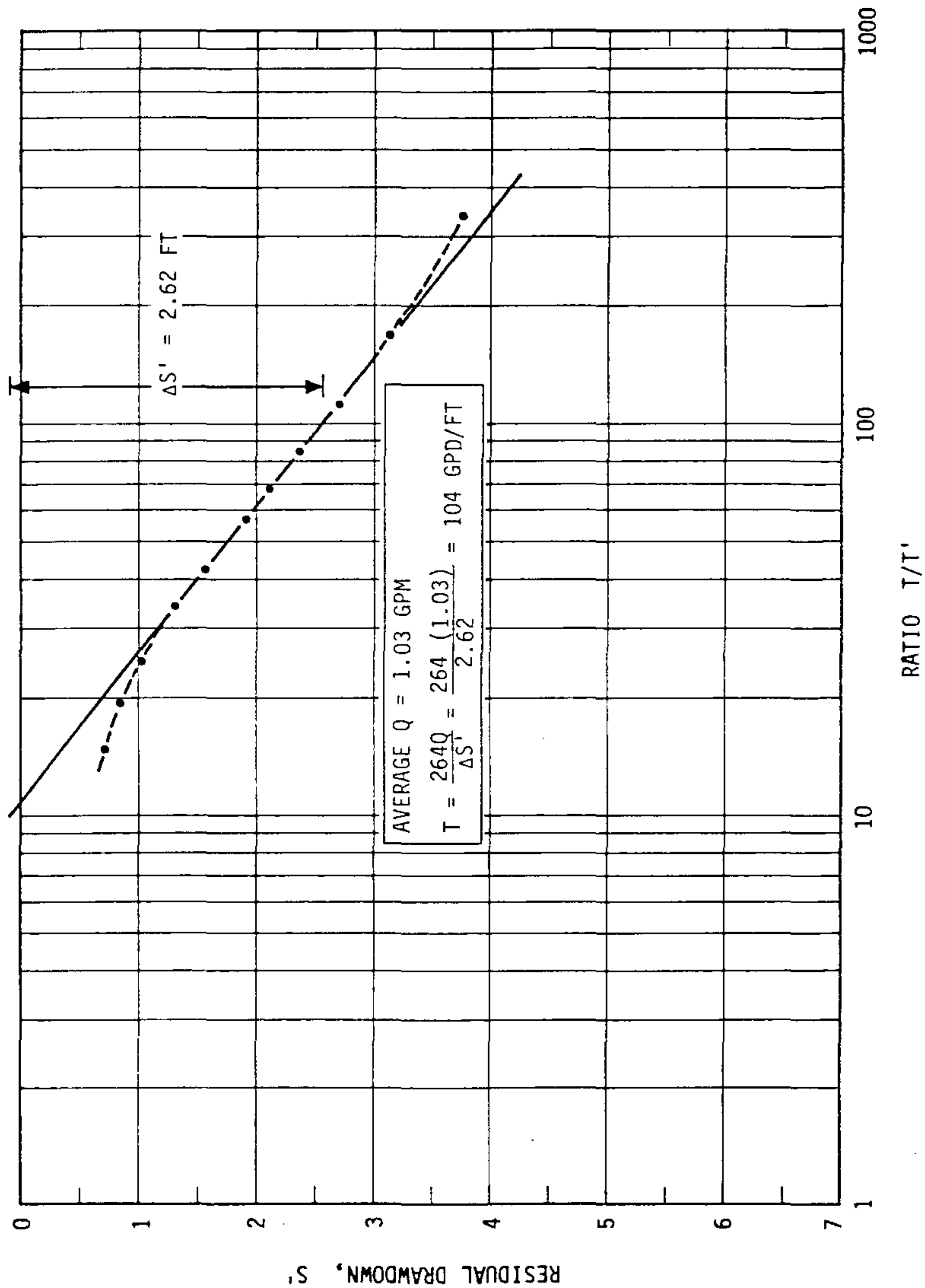
Project No. 90029A	PORT QUENDALL Renton, Washington	DRAWDOWN CURVE AND TRANSMISSIVITY CALCULATION FOR BORING 10	Appendix
Woodward-Clyde Consultants			



Project No. 90029A	PORT QUENDALL Renton, Washington	DRAWDOWN CURVE AND TRANSMISSIVITY CALCULATION FOR BORING 8	Appendix
Woodward-Clyde Consultants			



Project No. 90029A	PORT QUENDALL Renton, Washington	DRAWDOWN CURVE AND TRANSMISSIVITY CALCULATION FOR BORING 6	Appendix
Woodward-Clyde Consultants			



Project No. 90029A	PORT QUENDALL Renton, Washington	DRAWDOWN CURVE AND TRANSMISSIVITY CALCULATION FOR BORING 2A	Appendix
Woodward-Clyde Consultants			

APPENDIX D

ANALYTICAL METHODS AND RESULTS

NOTE: Data for samples collected offsite have been deleted from the laboratory data sheets in Sections D-5 and D-6.

APPENDIX D-1

DESCRIPTION OF THE ANALYTICAL METHODS FOR THE SOIL PAH SCREEN AND PENTACHLOROPHENOL ANALYSIS OF WATER

ABSORBANCE SCREEN ON SOILS

1. Weigh 1 +/- .05 g soil to a 250 ml beaker.
2. Add 10 ml DIW and adjust pH to 11 or greater.
3. Add 60 ml methylene chloride, extract 2 minutes with sonic probe.
4. Add sufficient anhydrous sodium sulfate to absorb all water; sonify an additional 30 sec.
5. Filter the extract. Rinse the retained material several times with $MeCl_2$.
6. Using the steam bath and a nitrogen stream, blow down the extracts.
7. Add 10 ml cyclohexane to the extracted material; swirl to dissolve.
8. Transfer the contents of the beaker to a culture tube with teflon lined lid.
9. Compare spectrophotometrically against a benzo(a)pyrene standard at 250 nm as follows:

B(a)P conc., ug/ml	equivalent soil %
0	0
1	.001
2	.002
5	.005
10	.010

10. Dilute the extracts as necessary to remain within the calibration curve.

PENTACHLOROPHENOL

(Sep-Pak Method)

1. Sep-Pak extraction.

   a. Take 250 ml sample to 400 ml beaker.
   b. Acidity with 5 ml conc. H_2SO_4.
   c. Pass through an activiated Sep-Pak.
   d. Elute from Sep-Pak with 1.5 ml CH_3CN.
   e. Extract is now ready for analysis.

2. HPLC Analysis.

   a. Instrument conditions

      Wavelength = 254 nm
      Mobile phase = 60% CH_3CN/40% H_2O + 0.1% HOAc
      Flow = 1 ml/min
      Chart = 0.1 in/min
      injection = 25 ul
      AFS = 0.01 AU
      Column - Zorbax C18, 5um

   b. Use standards of about 15, 7.5 ppm. This should give a detection limit of about 2 ug/L.

APPENDIX D-2

QUALITY ASSURANCE REPLICATE ANALYSES

Laucks
Testing Laboratories, Inc.
940 South Harney Street, Seattle, Washington 98108 (206) 767-5060
Chemistry, Microbiology, and Technical Services

Certificate

Woodward Clyde Consultants

LABORATORY NO 81030-c

Replicate Quality Control Report

Sample No.	Analyte	Replicate 1	Replicate 2	Relative Error, %	Control Limit
		parts per million (mg/L)			
155	Sodium	30.	32.	6.7	**
155	Potassium	22.	22.	0.	**
157	Sodium	25.	25.	0.	**
157	Potassium	13.	13.	0.	**
155	Sulfate	4.	3.	(1)	**
157	Calcium	38.	38.	0.	**
157	Magnesium	5.4	5.4	0.	**
161	Chloride	8.	8.	0.	**
167	Chloride	42.	43.	2.4	**
154	Nitrate	L/0.05	L/0.05	(0)	**
154	Alkalinity	280.	280.	0.	**
158	Nitrate	0.10	0.10	(0)	**
155	Calcium	64.	62.	3.1	**
155	Magnesium	28.	29.	3.6	**
		parts per billion (ug/L)			
149	2,4,6-trichlorophenol	3.46	21.7	84.*	**
149	pentachlorophenol	L/10.	L/10.	0.	0-3
149	benzo(k)fluoranthene	5.7	5.78	1.4	**
149	Total PNAs	5.7	6.24	9.5	**

The control limit is a statistically derived measure of the level of confidence in the measurement. These established control limits determine the range within which the analytical value will fall 95% of the time.

*Insufficient sample to repeat analysis. Duplicate analysis indicates a possible matrix problem.
**No control limits yet established.
Parentheses () indicate absolute, not relative, error.

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Certificate

Woodward Clyde Consultants

LABORATORY NO. 81030-d

Replicate Quality Control Report

%, by weight

Sample No.	Analyte	Replicate 1	Replicate 2	Relative Error, %
1	Fluor. Screen	0.005	0.015	(0.010)
15	"	L/0.001	L/0.001	(0)
30	"	0.004	0.002	(0.002)
45	"	0.081	0.058	28.
60	"	0.007	0.007	(0)
75	"	0.94	0.017	98.
90	"	1.0	0.90	10.
105	"	L/0.001	0.002	(0.002)
120	"	0.003	L/0.001	(0.003)
130	"	0.008	0.082	(0.074)
147	"	1.7	1.5	11.8

Comment

No control limits have yet been established. Nevertheless, one would expect a high variability in this determination due to the heterogeneous nature of soils and the fact that only 1-gram portions are used for the analysis.

Parentheses () indicate absolute, not relative, error.

APPENDIX D-3

QUALITY ASSURANCE SPIKING STUDY RESULTS

FOR INORGANIC PARAMETERS IN WATER SAMPLES

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LABORATORY NO. 81030-c

Spike Quality Control Report

parts per million (mg/L)

Sample No.	Analyte	Sample Found	Spike Level	Spike Found	% Recovery
155	Sodium	30.	25.	55.	100.
155	Potassium	22.	25.	50.	112.
157	Sodium	25.	25.	50.	100.
157	Potassium	13.	25.	40.	108.
157	Calcium	38.	25.	60.	88.
157	Magnesium	5.4	25.	31.	102.
161	Chloride	8.	36.	43.	97.
154	Nitrate	L/0.05	0.1	0.092	92.
158	Nitrate	0.10	0.10	0.19	90.
155	Calcium	64.	25.	84.	80.
155	Magnesium	28.	25.	54.	104.
162	Sulfate	22.	20.	45.	115.

APPENDIX D-4

QUALITY ASSURANCE SPIKING STUDY RESULTS FOR ORGANIC COMPOUNDS IN SOIL AND WATER

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Woodward-Clyde

LABORATORY NO. 81030-a

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of volatile compounds. The surrogates are added to every sample prior to analysis to monitor for matrix effects and purging efficiency. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

		mg/kg				
Sample #	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit	
BH-7	D5-phenol	20.0	12.0	59.8	10-104	
"	2-fluorophenol	20.0	15.4	77.0	26-116	
"	D5-nitrobenzene	20.0	14.8	74.0	19-115	
"	2-fluorobiphenyl	20.0	23.8	119.	17-125	
"	2-fluoroaniline	20.0	14.8	73.8	44-101	
"	D4-1,2-dichloroethane	45.5	41.4	91.0	50-150	
"	p-bromofluorobenzene	45.5	49.0	108.	57-137	
"	D8-toluene	45.5	49.7	109.	81-120	
"	1,2,3,4-TCDD	.0098	.161	1640.	18-128	*
"	isodrin	.0816	NA	NA	3-170	(1)
BH-8	D5-phenol	20.0	10.4	52.0	10-104	
"	2-fluorophenol	20.0	14.8	74.0	26-116	
"	D5-nitrobenzene	20.0	13.8	69.2	19-115	
"	2-fluorobiphenyl	20.0	26.5	133.	17-125	**
"	2-fluoroaniline	20.0	12.9	64.6	44-101	
"	D4-1,2-dichloroethane	41.7	43.5	104.	50-150	
"	p-bromofluorobenzene	41.7	51.2	123.	57-137	
"	D8-toluene	41.7	44.1	106.	81-120	
"	1,2,3,4-TCDD	.0092	151.		18-128	*
"	isodrin	.0766	NA	NA	3-170	(1)

(1) large interfering peak did not allow the accurate determination of isodrin
* matrix interference
**other surrogates indicate analysis in control
NA = not applicable

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Woodward Clyde Consultants

LABORATORY NO. 81030-d

Surrogate Recovery Quality Control Report

Listed below are surrogate compounds which are utlized in the analysis of priority pollutants. These compounds are added to every sample before extraction to provide quality control by monitoring for matrix effects and sample processing errors. The control limits represent the range in percent recovery which as been deemed acceptable by the EPA. 2-Fluoroaniline (2FA), 2-Fluorobiphenyl (2FB) and D5-Nitrobenzene (D5NB) represent base/neutral compounds.

parts per million (mg/kg), dry basis

Sample No.	Analyte	Spike Level	Spike Found	% Recovery	Control Limit
58	2-FB	24.2	21.2	87.6	30-100
58	D5-NB	24.2	23.8	98.3	40-120
58	2-FA	24.2	29.1	120.	40-120
69	2-FB	125.	7.0	5.6	30-100*
69	D5-NB	125.	5.3	4.2	40-120*
69	2-FA	125.	7.5	6.0	40-120*
102	2-FB	53.8	23.5	43.7	30-100
102	D5-NB	53.8	21.7	40.3	40-120
102	2-FA	53.8	26.7	49.6	40-120

The control limit is a statistically derived measure of the level of confidence in the measurement. These established control limits determine the range within which the analytical value will fall 95% of the time.

*Suspect a matrix interference problem.

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LABORATORY NO 81030-c

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of organic compounds. The surrogates are added to every sample prior to extraction to monitor for matrix effects and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

parts per billion (ug/L)

Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
148	benzo(k)fluoranthene	5.000	3.57	71.4	63-119
149	"	5.000	5.7	114.	"
150	"	5.000	3.00	60.0**	"
151	"	5.000	5.150	103.	"
152	"	5.000	4.57	91.4	"
153	"	5.000	100.	2000.*	"
154	"	5.123	4.99	97.4	"
155	"	5.076	5.18	102.	"
156	"	5.025	89.9	1790.*	"
157	"	5.051	115.	2280.*	"
158	"	5.181	490.	9460.*	"
159	"	5.263	6.47	123.*	"
160	"	5.435	21.9	404.*	"
161	"	5.181	3.83	74.0	"
162	"	5.000	4.02	80.4	"
163	"	5.000	3.84	76.8	"
164	"	5.000	3.79	75.8	"
167	"	5.181	4.87	94.	"
Blank	"	5.000	4.44	88.8	"
149 dup	"	5.780	4.52	78.2	"
148	2,4,6-trichlorophenol	100.0	84.0	84.0	"
149	"	100.0	3.46	3.5**	"
150	"	100.0	73.9	73.9	"

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LABORATORY NO. 81030-c

Surrogate Recovery Quality Control Report

parts per billion (ug/L)

Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
153	2,4,6-trichlorophenol	100.0	77.3	77.3	63-119
154	"	102.6	37.9	36.9**	"
159	"	105.3	84.9	80.6	"
162	"	100.0	67.2	67.2	"
Blank	"	100.0	97.5	97.5	"
150 spike	"	119.0	88.0	73.9	"
149 dup	"	115.6	21.7	18.8**	"

*Matrix interference.
**Insufficient sample to repeat analysis.

APPENDIX D-5

SOIL SAMPLE ANALYSIS RESULTS

Laucks
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940 South Harney Street, Seattle, Washington 98108 (206) 767-5060
Chemistry, Microbiology and Technical Services

Certificate

CLIENT Woodward-Clyde
100 Pringle Ave.
Walnut Creek, CA 94956

LABORATORY NO. 81030-a

DATE June 22, 1983

REPORT ON SOIL

SAMPLE IDENTIFICATION Marked:
7) BH-9 - D-7 - D. Spencer - 5-16-83
24) BH-2 - D-2 - D. Spencer - 5-17-83
58) BH-11 - D-8 - D. Spencer - 5-18-83
69) BH-4 - D-4 - D. Spencer - 5-18-83
76) BH-6 - D-4 - D. Spencer - 5-19-83
102) BH-10 - D-5 - D. Spencer - 5-20-83

TESTS PERFORMED AND RESULTS:

Samples reported as BH-7 and BH-9 were composited as follows prior to Priority Pollutant Analysis:

Composite Disignation	Samples Composited
BH-7	BH-7 - D-3, D-4, D-5
BH-9	BH-9 - D-2, D-6, D-7

Note on Fluorescence Screen: We were unable to visually compare sample extracts with benzo(a)pyrene standards due to differences in fluorescent color. However, the absorbance of the extracts was determined at 250 nm and compared to a B(a)P curve. The results of this determination are attached.

All back-up data will follow in a separate package.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

Mike Nelson

MN:vb

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Woodward-Clyde

LABORATORY NO. 81030-a

BH-7

Tentatively Identified Compound	Estimated Concentration ug/kg
ethylbenzene	84,600
1,3-dimethylbenzene	89,300
1,4-dimethylbenzene	38,200
1,3,4-trimethylbenzene	29,800
1,3,5-trimethylbenzene	64,300
benzofuran	49,000
ethyl-methyl-benzene	26,200
2,3-dihydro-1-H-indene	87,800
1H-indene	255,900
1-methyl-1H-indene	15,900
1-methyl-1H-indene	19,100
methyl naphthalene	137,300
1,1'-biphenyl	32,700
ethylnaphthalene *	23,000
dimethylnaphthalene *	31,600
dimethylnaphthalene *	57,900
9-H carbazole	33,200
methyl phenanthrene *	18,600
methyl phenanthrene *	24,800
methyl phenanthrene *	9,700
methyl phenanthrene *	15,000
methyl phenanthrene *	11,800
4H-cyclopenta(DEF)phenanthrene	33,000
1-phenyl-naphthalene	15,200
methyl pyrene	50,300

*response factor of isomer or similar compound.

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LABORATORY NO. 81030-a

BH-9

Tentatively Identified Compounds	Estimated Concentration ug/kg
ethylbenzene	128,300
1,3-dimethylbenzene	226,400
1,2,3-trimethylbenzene	97,800
2,3-dihydro-1H-indene	158,300
1-ethyhyl-4-methyl-benzene	201,600
2,3-dihydro-1-methyl-1H-indene	18,300
1,1'-biphenyl	104,100
2-ethylnaphthalene *	56,200
1,3-dimethylnaphthalene *	99,100
1,7-dimethylnaphthalene *	217,900
4-methyl-phenanthrene *	410,900
4H-cyclopenta(DEF)phenanthrene *	96,900

*response factors used for quantitation were taken from similar priority pollutants. All others - RF assumed to be 1.0

	7	24	58	69	76	102
Gravimetric Polycyclic Aromatic Hydrocarbons, per Washington State DOE WAC 173-302, % by weight, as received basis*	0.061	0.057	0.018	0.460	0.026	0.064
Fluorescence Screen, % as benzo(a)pyrene	0.03	0.002	0.01	0.44	0.01	0.002

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Woodward-Clyde

LABORATORY NO. 81030-a

	7	24	58	69	76	102
Volatile Aromatics, mg/kg, as received						
benzene	2.1	L/0.2	L/0.2	0.3	L/0.2	L/0.2
toluene	5.2	L/0.2	L/0.2	L/0.2	L/0.2	L/0.2
xylene	7.3	L/0.4	L/0.4	L/0.4	L/0.4	L/0.4
methylbenzene & styrene	4.3	L/0.4	L/0.4	L/0.4	L/0.4	L/0.4

U.S. ENVIRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
P.O. Box 818, Alexandria, Virginia 22313 - 703/557-2490

Sample Number: BH-7

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: Laucks Testing Laboratories, Inc
Case No: Woodward-Clyde
Lab Sample I.D. No: 81030-1
QC Report No:

Multiply Detection Limits by 1 ☐ or 10 ☒ 20 (Check Box for Appropriate Factor)

ACID COMPOUNDS

PP #	CAS #		ug/l or ug/kg X (circle one)
(21A)	88-06-2	2,4,6- trichlorophenol	L/200
(22A)	59-50-7	p-chloro-m-cresol	L/200
(24A)	95-57-8	2- chlorophenol	L/200
(31A)	120-83-2	2,4-dichlorophenol	L/200
(34A)	105-67-9	2,4-dimethylphenol	27,500
(57A)	88-75-5	2- nitrophenol	L/400
(58A)	100-02-7	4-nitrophenol	L/1000
(59A)	51-28-5	2,4-dinitrophenol	L/1000
(60A)	534-52-1	4,6-dinitro-2-methylphenol	L/400
(64A)	87-86-5	pentachlorophenol	L/200
(65A)	108-95-2	phenol	L/200

BASE/NEUTRAL COMPOUNDS

PP #	CAS #		ug/l or ug/kg X (circle one)
(1B)	83-32-9	acenaphthene	159,300
(5B)	92-87-5	benzidine	L/800
(8B)	120-82-1	1,2,4-trichlorobenzene	L/200
(9B)	118-74-1	hexachlorobenzene	L/200
(12B)	67-72-1	hexachloroethane	L/200
(18B)	111-44-4	bis(2-chloroethyl)ether	L/200
(20B)	91-58-7	2-chloronaphthalene	L/200
(25B)	95-50-1	1,2-dichlorobenzene	L/200
(26B)	541-73-1	1,3-dichlorobenzene	L/200
(27B)	106-46-7	1,4-dichlorobenzene	L/200
(28B)	91-94-1	3,3'-dichlorobenzidine	L/400
(35B)	121-14-2	2,4-dinitrotoluene	L/400
(36B)	606-20-2	2,6-dinitrotoluene	L/400
(37B)	122-66-7	1,2-diphenylhydrazine	L/400
(39B)	206-44-0	fluoranthene	166,800
(40B)	7005-72-3	4-chlorophenyl phenyl ether	L/200
(41B)	101-55-3	4-bromophenyl phenyl ether	L/200
(42B)	39638-32-9	bis (2-chloroisopropyl) ether	L/400
(43B)	111-91-1	bis (2-chloroethoxy) methane	L/400
(52B)	87-68-3	hexachlorobutadiene	L/200
(53B)	77-47-4	hexachlorocyclopentadiene	L/200
(54B)	78-59-1	isophorone	L/200
(55B)	91-20-3	naphthalene	1,139,000
(56B)	98-95-3	nitrobenzene	L/200
(62B)	86-30-6	N-nitrosodiphenylamine	L/200
(63B)	621-64-7	N-nitrosodipropylamine	L/200
(66B)	117-81-7	bis (2-ethylhexyl) phthalate	L/200
(67B)	85-68-7	benzyl butyl phthalate	L/200
(68B)	84-74-2	di-n-butyl phthalate	L/200
(69B)	117-84-0	di-n-octyl phthalate	L/200
(70B)	84-66-2	diethyl phthalate	L/200
(71B)	131-11-3	dimethyl phthalate	L/200
(72B)	56-55-3	benzo(a)anthracene	68,000
(73B)	50-32-8	benzo(a)pyrene	150,000
(74B)	205-99-2	benzo(b)fluoranthene	97,400
(75B)	207-08-9	benzo(k)fluoranthene	
(76B)	218-01-9	chrysene	80,600
(77B)	208-96-8	acenaphthylene	71,500
(78B)	120-12-7	anthracene	74,400
(79B)	191-24-2	benzo(ghi)perylene	44,100
(80B)	86-73-7	fluorene	96,500
(81B)	85-01-8	phenanthrene	304,300
(82B)	53-70-3	dibenzo(a,h)anthracene	11,000
(83B)	193-39-5	indeno(1,2,3-cd)pyrene	36,500
(84B)	129-00-0	pyrene	163,000

VOLATILES

PP #	CAS #		ug/l or ug/kg X (circle one)
(2V)	107-02-8	acrolein	L/50
(3V)	107-13-1	acrylonitrile	L/50
(4V)	71-43-2	benzene	1,130
(6V)	56-23-5	carbon tetrachloride	L/50
(7V)	108-90-7	chlorobenzene	L/50
(10V)	107-06-2	1,2-dichloroethane	L/50
(11V)	71-55-6	1,1,1-trichloroethane	L/50
(13V)	75-34-3	1,1-dichloroethane	L/50
(14V)	79-00-5	1,1,2-trichloroethane	L/50
(15V)	79-34-5	1,1,2,2-tetrachloroethane	L/50
(16V)	75-00-3	chloroethane	L/50
(19V)	110-75-8	2-chloroethylvinyl ether	L/50
(23V)	67-66-3	chloroform	L/50
(29V)	75-35-4	1,1-dichloroethene	L/50
(30V)	156-60-5	trans-1,2-dichloroethene	L/50
(32V)	78-87-5	1,2-dichloropropane	L/50
(33V)	10061-02-6	trans-1,3-dichloropropene	L/50
	10061-01-05	cis-1,3-dichloropropene	L/50
(38V)	100-41-4	ethylbenzene	27,000
(44V)	75-09-2	methylene chloride	19,300
(45V)	74-87-3	chloromethane	L/50
(46V)	74-83-9	bromomethane	L/50
(47V)	75-25-2	bromoform	L/50
(48V)	75-27-4	bromodichloromethane	L/50
(49V)	75-69-4	fluorotrichloromethane	L/50
(50V)	75-71-8	dichlorodifluoromethane	L/50
(51V)	124-48-1	chlorodibromomethane	L/50
(85V)	127-18-4	tetrachloroethene	L/50
(86V)	108-88-3	toluene	10,150
(87V)	79-01-6	trichloroethene	L/50
(88V)	75-01-4	vinyl chloride	L/50

ORGANICS ANALYSIS DATA SHEET - Page 2

Sample Number
BH-7

Laboratory Name: Laucks Testing Laboratories, Inc. Case No: Woodward-Clyde

Lab Sample I.D. No: 81030-1 QC Report No:

Multiply Detection Limits by 1 ☐ or 10 ☐ (Check Box for Appropriate Factor)
20 X

PESTICIDES

PP #	CAS #		ug/l or ug/kg X (circle one)
(89P)	309-00-2	aldrin	7
(90P)	60-57-1	dieldrin	L/5
(91P)	57-74-9	chlordane	L/5
(92P)	50-29-3	4,4'-DDT	L/5
(93P)	72-55-9	4,4'-DDE	L/5
(94P)	72-54-8	4,4'-DDD	L/5
(95P)	115-29-7	α-endosulfan	L/5
(96P)	115-29-7	β-endosulfan	L/5
(97P)	1031-07-8	endosulfan sulfate	L/5
(98P)	72-20-8	endrin	L/5
(99P)	7421-93-4	endrin aldehyde	L/5
(100P)	76-44-8	heptachlor	L/5
(101P)	1024-57-3	heptachlor epoxide	L/5
(102P)	319-84-6	α-BHC	L/5

PESTICIDES

PP #	CAS #		ug/l or ug/kg X (circle one)
(103P)	319-85-7	β-BHC	L/5
(104P)	319-86-8	δ-BHC	L/5
(105P)	58-89-9	γ-BHC (lindane)	L/5
(106P)	53469-21-9	PCB-1242	L/50
(107P)	11097-69-1	PCB-1254	L/50
(108P)	11104-28-2	PCB-1221	L/50
(109P)	11141-16-5	PCB-1232	L/50
(110P)	12672-29-6	PCB-1248	L/50
(111P)	11096-82-5	PCB-1260	L/50
(112P)	12674-11-2	PCB-1016	L/50
(113P)	8001-35-2	toxaphene	L/500

DIOXINS

(129B)	1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	L/0.71

Non-Priority Pollutant Hazardous Substances List Compounds

ACID COMPOUNDS

CAS #		ug/l or ug/kg X (circle one)
65-85-0	benzoic acid	L/2,000
95-48-7	2-methylphenol	15,700
108-39-4	4-methylphenol	30,400
95-95-4	2,4,5-trichlorophenol	L/2,000

BASE/NEUTRAL COMPOUNDS

62-53-3	aniline	L/100
100-51-6	benzyl alcohol	L/400
106-47-8	4-chloroaniline	L/1,000
132-64-9	dibenzofuran	72,900
91-57-6	2-methylnaphthalene	265,000
88-74-4	2-nitroaniline	L/2,000
99-09-2	3-nitroaniline	L/2,000
100-01-6	4-nitroaniline	L/2,000

VOLATILES

CAS #		ug/l or ug/kg X (circle one)
67-64-1	acetone	L/75
78-93-3	2-butanone	L/75
75-15-0	carbondisulfide	L/50
519-78-6	2-hexanone	L/75
108-10-1	4-methyl-2-pentanone	L/50
100-42-5	styrene	L/50
108-05-4	vinyl acetate	L/50
95-47-6	o-xylene	58,400

U.S. ENVIRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
P.O. Box 818, Alexandria, Virginia 22313 - 703/557-2490

Sample Number
BH-9

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: Laucks Testing Laboratories, Inc Case No: Woodward-Clyde
Lab Sample I.D. No: 81030-2 QC Report No:

Multiply Detection Limits by 1 ☐ or 10 ☐ 20 X (Check Box for Appropriate Factor)

ACID COMPOUNDS

PP #	CAS #		ug/l or ug/kg X (circle one)
(21A)	88-06-2	2,4,6- trichlorophenol	L/200
(22A)	59-50-7	p-chloro-m-cresol	L/200
(24A)	95-57-8	2- chlorophenol	L/200
(31A)	120-83-2	2,4-dichlorophenol	L/200
(34A)	105-67-9	2,4-dimethylphenol	L/200
(57A)	88-75-5	2- nitrophenol	L/400
(58A)	100-02-7	4-nitrophenol	L/1,000
(59A)	51-28-5	2,4-dinitrophenol	L/1,000
(60A)	534-52-1	4,6-dinitro-2-methylphenol	L/400
(64A)	87-86-5	pentachlorophenol	L/200
(65A)	108-95-2	phenol	L/200

BASE/NEUTRAL COMPOUNDS

PP #	CAS #		ug/l or ug/kg X (circle one)
(1B)	83-32-9	acenaphthene	515,000
(5B)	92-87-5	benzidine	L/800
(8B)	120-82-1	1,2,4-trichlorobenzene	L/200
(9B)	118-74-1	hexachlorobenzene	L/200
(12B)	67-72-1	hexachloroethane	L/200
(18B)	111-44-4	bis(2-chloroethyl)ether	L/200
(20B)	91-58-7	2-chloronaphthalene	L/200
(25B)	95-50-1	1,2-dichlorobenzene	L/200
(26B)	541-73-1	1,3-dichlorobenzene	L/200
(27B)	106-46-7	1,4-dichlorobenzene	L/200
(28B)	91-94-1	3,3'-dichlorobenzidine	L/400
(35B)	121-14-2	2,4-dinitrotoluene	L/400
(36B)	606-20-2	2,6-dinitrotoluene	L/400
(37B)	122-66-7	1,2-diphenylhydrazine	L/400
(39B)	206-44-0	fluoranthene	368,000
(40B)	7005-72-3	4-chlorophenyl phenyl ether	L/200
(41B)	101-55-3	4-bromophenyl phenyl ether	L/200
(42B)	39638-32-9	bis (2-chloroisopropyl) ether	L/400
(43B)	111-91-1	bis (2-chloroethoxy) methane	L/400
(52B)	87-68-3	hexachlorobutadiene	L/200
(53B)	77-47-4	hexachlorocyclopentadiene	L/200
(54B)	78-59-1	isophorone	L/200
(55B)	91-20-3	naphthalene	2,168,000
(56B)	98-95-3	nitrobenzene	L/200
(62B)	86-30-6	N-nitrosodiphenylamine	L/200
(63B)	621-64-7	N-nitrosodipropylamine	L/200
(66B)	117-81-7	bis (2-ethylhexyl) phthalate	L/200
(67B)	85-68-7	benzyl butyl phthalate	L/200
(68B)	84-74-2	di-n-butyl phthalate	L/200
(69B)	117-84-0	di-n-octyl phthalate	L/200
(70B)	84-66-2	diethyl phthalate	L/200
(71B)	131-11-3	dimethyl phthalate	L/200
(72B)	56-55-3	benzo(a)anthracene	197,000

BASE/NEUTRAL COMPOUNDS

PP #	CAS #		ug/l or ug/kg X (circle one)
(73B)	50-32-8	benzo(a)pyrene	254,600
(74B)	205-99-2	benzo(b)fluoranthene	27,600
(75B)	207-08-9	benzo(k)fluoranthene	
(76B)	218-01-9	chrysene	152,600
(77B)	208-96-8	acenaphthylene	185,000
(78B)	120-12-7	anthracene	258,000
(79B)	191-24-2	benzo(ghi)perylene	56,900
(80B)	86-73-7	fluorene	279,000
(81B)	85-01-8	phenanthrene	1,061,000
(82B)	53-70-3	dibenzo(a,h)anthracene	60,900
(83B)	193-39-5	indeno(1,2,3-cd)pyrene	54,800
(84B)	129-00-0	pyrene	400,000

VOLATILES

PP #	CAS #		ug/l or ug/kg X (circle one)
(2V)	107-02-8	acrolein	L/50
(3V)	107-13-1	acrylonitrile	L/50
(4V)	71-43-2	benzene	2,300
(6V)	56-23-5	carbon tetrachloride	L/50
(7V)	108-90-7	chlorobenzene	L/50
(10V)	107-06-2	1,2-dichloroethane	L/50
(11V)	71-55-6	1,1,1-trichloroethane	L/50
(13V)	75-34-3	1,1-dichloroethane	L/50
(14V)	79-00-5	1,1,2-trichloroethane	L/50
(15V)	79-34-5	1,1,2,2-tetrachloroethane	L/50
(16V)	75-00-3	chloroethane	L/50
(19V)	110-75-8	2-chloroethylvinyl ether	L/50
(23V)	67-66-3	chloroform	L/50
(29V)	75-35-4	1,1-dichloroethene	L/50
(30V)	156-60-5	trans-1,2-dichloroethene	L/50
(32V)	78-87-5	1,2-dichloropropane	L/50
(33V)	10061-02-6	trans-1,3-dichloropropene	L/50
	10061-01-05	cis-1,3-dichloropropene	L/50
(38V)	100-41-4	ethylbenzene	34,600
(44V)	75-09-2	methylene chloride	36,700
(45V)	74-87-3	chloromethane	L/50
(46V)	74-83-9	bromomethane	L/50
(47V)	75-25-2	bromoform	L/50
(48V)	75-27-4	bromodichloromethane	L/50
(49V)	75-69-4	fluorotrichloromethane	L/50
(50V)	75-71-8	dichlorodifluoromethane	L/50
(51V)	124-48-1	chlorodibromomethane	L/50
(85V)	127-18-4	tetrachloroethene	L/50
(86V)	108-88-3	toluene	12,000
(87V)	79-01-6	trichloroethene	L/50
(88V)	75-01-4	vinyl chloride	L/50

ORGANICS ANALYSIS DATA SHEET - Page 2

Sample Number
BH-9

Laboratory Name: Laucks Testing Laboratories, Inc. Case No: Woodward-Clyde

Lab Sample I.D. No: 81030-2 QC Report No:

Multiply Detection Limits by 1 ☐ or 10 ☐ 20 X (Check Box for Appropriate Factor)

PESTICIDES

PP #	CAS #		ug/l or ug/kg X (circle one)
(89P)	309-00-2	aldrin	130
(90P)	60-57-1	dieldrin	L/20
(91P)	57-74-9	chlordane	L/20
(92P)	50-29-3	4,4'-DDT	L/50
(93P)	72-55-9	4,4'-DDE	L/20
(94P)	72-54-8	4,4'-DDD	L/20
(95P)	115-29-7	α-endosulfan	L/20
(96P)	115-29-7	β-endosulfan	L/20
(97P)	1031-07-8	endosulfan sulfate	L/50
(98P)	72-20-8	endrin	L/20
(99P)	7421-93-4	endrin aldehyde	L/20
(100P)	76-44-8	heptachlor	L/20
(101P)	1024-57-3	heptachlor epoxide	50*
(102P)	319-84-6	α-BHC	L/20

*possible positive matrix interference

PESTICIDES

PP #	CAS #		ug/l or ug/kg X (circle one)
(103P)	319-85-7	β-BHC	L/20
(104P)	319-86-8	δ-BHC	L/20
(105P)	58-89-9	γ-BHC (lindane)	180
(106P)	53469-21-9	PCB-1242	L/200
(107P)	11097-69-1	PCB-1254	L/200
(108P)	11104-28-2	PCB-1221	L/200
(109P)	11141-16-5	PCB-1232	L/200
(110P)	12672-29-6	PCB-1248	L/200
(111P)	11096-82-5	PCB-1260	L/200
(112P)	12674-11-2	PCB-1016	L/200
(113P)	8001-35-2	toxaphene	L/2000

DIOXINS

(129B)	1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	L/0.71

Non-Priority Pollutant Hazardous Substances List Compounds

ACID COMPOUNDS

CAS #		ug/l or ug/kg X (circle one)
65-85-0	benzoic acid	L/2000
95-48-7	2-methylphenol	7800
108-39-4	4-methylphenol	L/100
95-95-4	2,4,5-trichlorophenol	L/2000

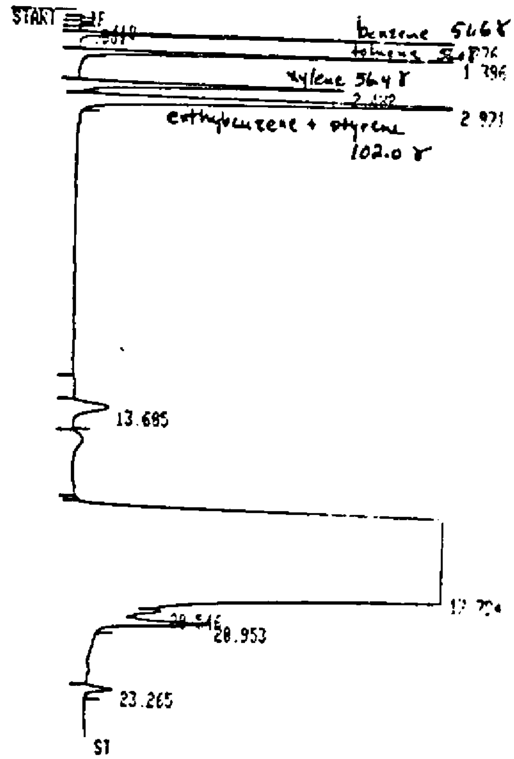
BASE/NEUTRAL COMPOUNDS

62-53-3	aniline	L/100
100-51-6	benzyl alcohol	L/400
106-47-8	4-chloroaniline	L/1000
132-64-9	dibenzofuran	139,000
91-57-6	2-methylnaphthalene	1,083,000
88-74-4	2-nitroaniline	L/2000
99-09-2	3-nitroaniline	L/2000
100-01-6	4-nitroaniline	L/2000

VOLATILES

CAS #		ug/l or ug/kg X (circle one)
67-64-1	acetone	L/75
78-93-3	2-butanone	L/75
75-15-0	carbondisulfide	L/50
519-78-6	2-hexanone	L/75
108-10-1	4-methyl-2-pentanone	L/50
100-42-5	styrene	L/50
108-05-4	vinyl acetate	L/50
95-47-6	o-xylene	56,900

aromatic Std



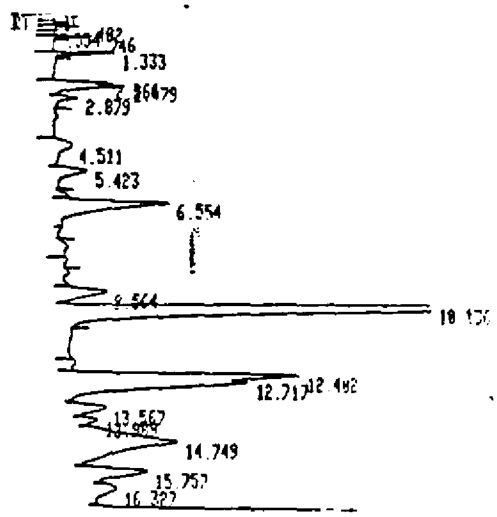
RUN # 42 JUN/21/83 17:10:17

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.418	16333	BB	0.037	0.193
0.581	4973	PB	0.042	0.059
0.776	958092	PB	0.050	11.310
1.396	637422	PB	0.080	7.525
2.482	326845	PB	0.132	3.849
2.921	497837	BB	0.192	5.877
13.685	43370	BB	0.332	0.512
17.794	5827184 ↑	PB	1.032	68.788
20.546	17772	BB	0.122	0.210
20.953	108708	BB	0.150	1.283
23.265	33512	BB	0.171	0.396

TOTAL HGHT= 8471200
MUL FACTOR= 1.0000E+00

030-7



STOP

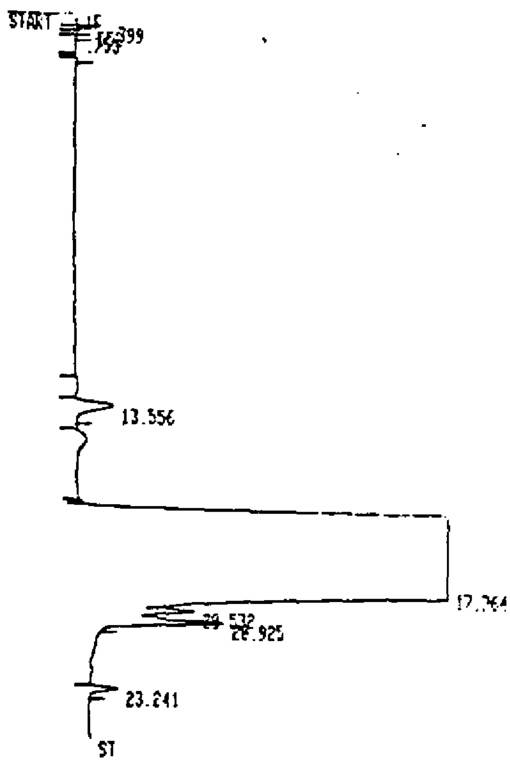
RUN # 40 JUN/21/83 15:41:32

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.482	30911	BB	0.033	1.634
0.554	4918	PB	0.039	0.260
0.746	47762	PB	0.049	2.525
1.333	72337	PB	0.078	3.824
2.366	12931	PB	0.000	0.684
2.479	38921	BB	0.060	2.058
2.879	25436	BB	0.150	1.345
4.511	21603	BB	0.391	1.142
5.423	38779	BB	0.261	2.050
6.554	124335	BB	0.285	6.573
9.564	47232	BB	0.273	2.497
10.136	975575	BB	0.251	51.573
12.482	154362	PB	0.169	8.160
12.717	36575	BB	0.099	1.934
13.567	36169	BB	0.269	1.912
13.989	16046	BB	0.165	0.848
14.749	114054	BB	0.566	6.029
15.757	70476	BB	0.275	3.726
16.327	23225	BB	0.332	1.228

TOTAL HGHT= 1891680
MUL FACTOR= 1.0000E+00

030-8



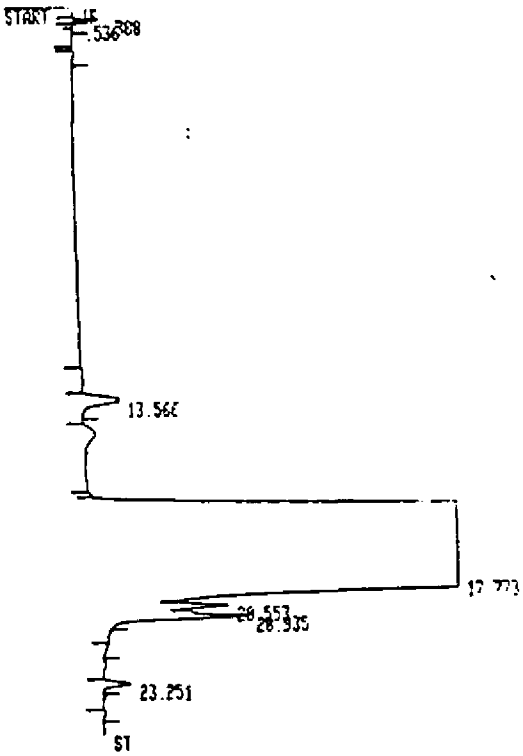
RUN # 38 JUN/21/83 14:10:52

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.399	30285	PB	0.032	0.490
0.552	5424	BB	0.041	0.088
0.753	3984	PB	0.046	0.065
13.556	46172	BB	0.315	0.747
17.764	5900908 †	PB	1.055	95.469
20.532	45065	BB	0.129	0.729
20.925	114981	BB	0.159	1.860
23.241	34139	BB	0.171	0.552

TOTAL HGHT= 6181000
MUL FACTOR= 1.0000E+00

030 - 58



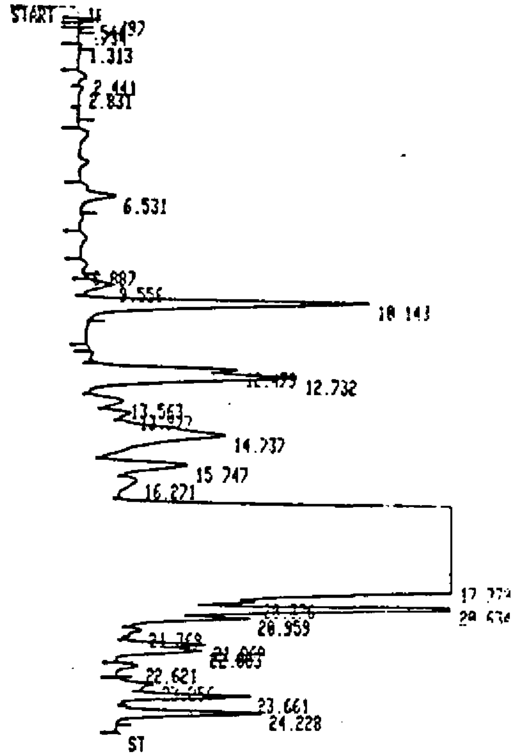
RUN # 39 JUN/21/83 14:57:43

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.398	31650	BB	0.036	0.509
0.536	4897	BB	0.050	0.079
13.566	46090	BB	0.320	0.741
17.773	5923424 ↑	PB	1.063	95.249
20.553	62207	BB	0.130	1.000
20.935	116195	BB	0.154	1.868
23.251	34415	BB	0.170	0.553

TOTAL HGHT= 6218900
MUL FACTOR= 1.0000E+00

030 - 69

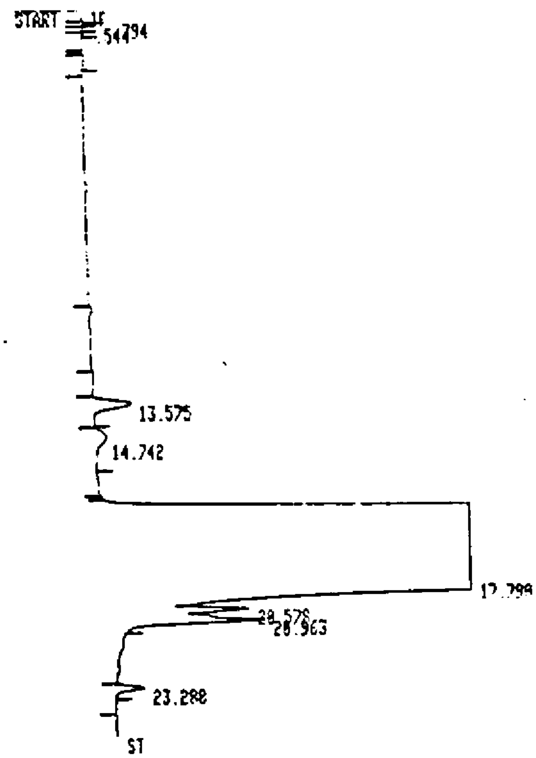


RUN # 41 JUN/21/83 16:26:15

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.397	28512	PB	0.033	0.264
0.544	5187	PB	0.039	0.048
0.734	6813	BB	0.047	0.063
1.313	5974	PB	0.075	0.055
2.441	10359	PB	0.212	0.096
2.831	5827	BB	0.180	0.054
6.531	44104	PB	0.296	0.409
8.887	6554	PB	0.190	0.061
9.556	33579	BB	0.277	0.311
10.143	350935	BB	0.260	3.254
12.479	64839	PB	0.127	0.601
12.732	131726	BB	0.160	1.221
13.563	32455	BB	0.263	0.301
13.977	24489	BB	0.179	0.227
14.737	138926	BB	0.533	1.288
15.747	93657	BB	0.277	0.868
16.271	17732	BB	0.323	0.164
17.779	8575164 ↑	BB	2.288	79.501
20.376	27737	BB	0.087	0.257
20.634	585052	BB	0.145	5.424
20.959	93225	BB	0.120	0.864
21.369	15205	BB	0.132	0.141
21.869	61189	PB	0.125	0.567
22.083	49300	BB	0.054	0.457
22.621	26682	BB	0.161	0.247
23.256	29122	PB	0.166	0.270
23.661	145624	[illegible]	[illegible]	[illegible]

030-76



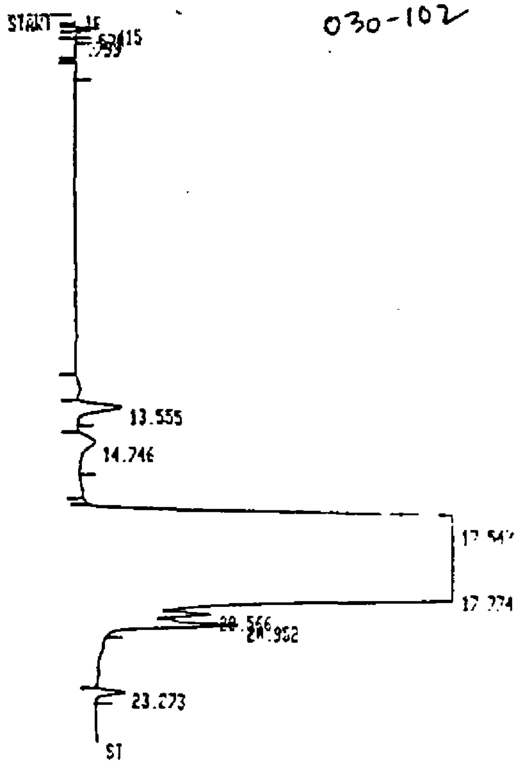
RUN # 37 JUN/21/83 13:25:50

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.394	27979	BB	0.036	0.448
0.544	5373	PB	0.046	0.086
13.575	47600	PB	0.317	0.763
14.742	14974	BB	0.536	0.240
17.798	5924948 ↑	PB	1.070	94.906
20.578	68325	PB	0.132	1.094
20.963	119081	BB	0.163	1.907
23.288	34715	BB	0.173	0.556

TOTAL HGHT= 6243000
MUL FACTOR= 1.0000E+00

030-102



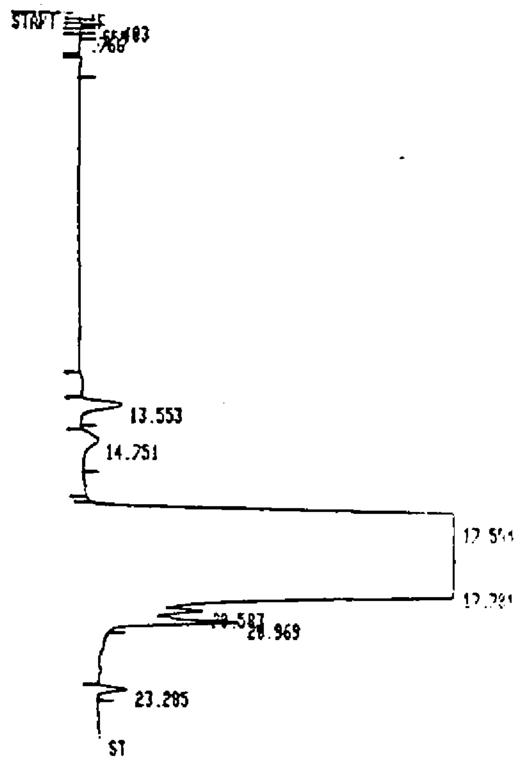
RUN # 34 JUN/21/83 10:54:51

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.415	27570	PB	0.035	0.490
0.578	5355	BB	0.044	0.078
0.799	3938	PB	0.049	0.057
13.555	52806	BB	0.282	0.767
14.746	20910	BB	0.490	0.304
17.543	163953	PB	0.000	2.380
17.774	6408444 ↑	BB	2.470	93.033
20.566	52724	BB	0.130	0.765
20.952	117335	BB	0.152	1.703
23.273	35322	BB	0.173	0.513

TOTAL HGHT= 6888400
MUL FACTOR= 1.0000E+00

21030 - 102 d



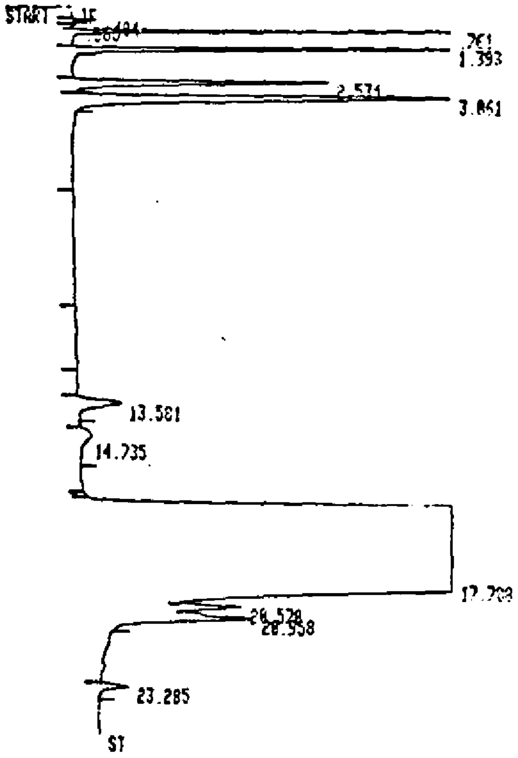
RUN # 35 JUN/21/83 11:29:18

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.403	30731	BB	0.035	0.446
0.559	5323	PB	0.041	0.077
0.766	4247	BB	0.048	0.062
13.553	50571	PB	0.304	0.734
14.751	20738	BB	0.501	0.301
17.554	149399	PB	0.000	2.167
17.781	6435896 ↑	BB	2.485	93.358
20.583	41991	BB	0.129	0.609
20.969	119801	BB	0.154	1.726
23.285	35905	BB	0.173	0.521

TOTAL HGHT= 6893000
MUL FACTOR= 1.0000E+00

037 - 102 sp



RUN # 36 JUN/21/83 12:33:39

HEIGHT%

RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.404	29545	BB	0.035	0.348
0.566	5276	BB	0.054	0.062
0.761	945755	BB	0.051	11.146
1.393	625453	PB	0.083	7.371
2.534	312073	PB	0.141	3.678
3.061	470604	PB	0.214	5.546
13.581	53653	PB	0.283	0.632
14.735	15099	BB	0.473	0.178
17.788	5803712 ↑	PB	1.060	68.399
20.570	70100	BB	0.134	0.826
20.958	118806	BB	0.164	1.400
23.285	35032	BB	0.179	0.413

TOTAL HGHT= 8485100
MUL FACTOR= 1.0000E+00

Laucks
Testing Laboratories, Inc.

940 South Harney Street. Seattle. Washington 98108 (206) 767-5060

Chemistry, Microbiology and Technical Services

Certificate

CLIENT Woodward Clyde Consultants
100 Pringle Avenue
Walnut Creek, CA 94596
ATTN: Tom Bailey

LABORATORY NO. 81030-d

DATE August 8, 1983

REPORT ON SOIL

SAMPLE IDENTIFICATION Marked as shown below:

TESTS PERFORMED AND RESULTS:

1)	BH-9	D-1	D. Spencer	5/16
2)	BH-9	D-2	D. Spencer	5/16
3)	BH-9	D-3	D. Spencer	5/16
4)	BH-9	D-4	D. Spencer	5/16
5)	BH-9	D-5	D. Spencer	5/16
6)	BH-9	D-6	D. Spencer	5/16
8)	BH-9	D-8	D. Spencer	5/16
9)	BH-16	D-1	D. Spencer	5/16
10)	BH-16	D-2	D. Spencer	5/16
11)	BH-16	D-3	D. Spencer	5/16
12)	BH-16	D-4	D. Spencer	5/16
13)	BH-16	D-6	D. Spencer	5/16
14)	BH-16	D-7	D. Spencer	5/16
15)	BH-16	D-8	D. Spencer	5/16
16)	BH-16	D-9	D. Spencer	5/16
17)	BH-1	D-1	D. Spencer	5/17
18)	BH-1	D-2	D. Spencer	5/17
19)	BH-1	D-3	D. Spencer	5/17
20)	BH-1	D-4	D. Spencer	5/17
21)	BH-1	D-5	D. Spencer	5/17
22)	BH-1	D-6	D. Spencer	5/17
23)	BH-1	D-7	D. Spencer	5/17
25)	BH-2	D-3	D. Spencer	5/17
26)	BH-2	D-4	D. Spencer	5/17
27)	BH-2	D-5	D. Spencer	5/17
28)	BH-2	D-6	D. Spencer	5/17
29)	BH-2	D-7	D. Spencer	5/17
30)	BH-12	D-1	D. Spencer	5/17
31)	BH-12	D-2	D. Spencer	5/17
32)	BH-12	D-3	D. Spencer	5/17
33)	BH-12	D-4	D. Spencer	5/17
34)	BH-12	D-5	D. Spencer	5/17
35)	BH-12	D-6	D. Spencer	5/17
36)	BH-15	D-1	D. Spencer	5/17

Laucks
Testing Laboratories, Inc.
940 South Harney Street, Seattle, Washington 98108 (206) 767-5060
Chemistry, Microbiology, and Technical Services

Certificate

LABORATORY NO. 81030-d

Woodward Clyde Consultants

37)	BH-15	D-2	D. Spencer	5/17
38)	BH-15	D-3	D. Spencer	5/17
39)	BH-15	D-4	D. Spencer	5/17
40)	BH-15	D-5	D. Spencer	5/17
41)	BH-15	D-6	D. Spencer	5/17
42)	BH-15	D-7	D. Spencer	5/17
43)	BH-2	D-1	D. Spencer	5/17
44)	BH-7	D-1	D. Spencer	5/18
45)	BH-7	D-2	D. Spencer	5/18
46)	BH-7	D-3	D. Spencer	5/18
47)	BH-7	D-4	D. Spencer	5/18
48)	BH-7	D-5	D. Spencer	5/18
49)	BH-7	D-6	D. Spencer	5/18
50)	BH-7	D-7	D. Spencer	5/18
51)	BH-11	D-1	D. Spencer	5/18
52)	BH-11	D-2	D. Spencer	5/18
53)	BH-11	D-3	D. Spencer	5/18
54)	BH-11	D-4	D. Spencer	5/18
55)	BH-11	D-5	D. Spencer	5/18
56)	BH-11	D-6	D. Spencer	5/18
57)	BH-11	D-7	D. Spencer	5/18
58)	BH-11	D-8	D. Spencer	5/18
59)	BH-14	D-1	D. Spencer	5/18
60)	BH-14	D-2	D. Spencer	5/18
61)	BH-14	D-3	D. Spencer	5/18
62)	BH-14	D-4	D. Spencer	5/18
63)	BH-14	D-5	D. Spencer	5/18
64)	BH-14	D-6	D. Spencer	5/18
65)	BH-14	D-7	D. Spencer	5/18
66)	BH-4	D-1	D. Spencer	5/18
67)	BH-4	D-2	D. Spencer	5/18
68)	BH-4	D-3	D. Spencer	5/18
69)	BH-4	D-4	D. Spencer	5/18
70)	BH-4	D-5	D. Spencer	5/18
71)	BH-4	D-6	D. Spencer	5/18
72)	BH-4	D-7	D. Spencer	5/18
73)	BH-6	D-1	D. Spencer	5/19
74)	BH-6	D-2	D. Spencer	5/19

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LABORATORY NO. 81030-d

75)	BH-6	D-3	D. Spencer	5/19	
77)	BH-6	D-5	D. Spencer	5/19	
78)	BH-6	D-6	D. Spencer	5/19	
79)	BH-8	D-1	D. Spencer	5/19	
80)	BH-8	D-2	D. Spencer	5/19	
81)	BH-8	D-3	D. Spencer	5/19	
82)	BH-8	D-4	D. Spencer	5/19	
83)	BH-8	D-5	D. Spencer	5/19	
84)	BH-8	D-6	D. Spencer	5/19	
85)	BH-8	D-7	D. Spencer	5/19	
86)	BH-8	D-8	D. Spencer	5/19	
87)	BH-8	D-9	D. Spencer	5/19	
88)	BH-12	D-7	D. Spencer	5/19	23'
89)	BH-5	D-1	D. Spencer	5/20	
90)	BH-5	D-2	D. Spencer	5/20	
91)	BH-5	D-3	D. Spencer	5/20	
92)	BH-5	D-4	D. Spencer	5/20	
93)	BH-5	D-5	D. Spencer	5/20	
94)	BH-5	D-6	D. Spencer	5/20	
95)	BH-5	D-7	D. Spencer	5/20	
96)	BH-5	D-8	D. Spencer	5/20	
97)	BH-5	D-9	D. Spencer	5/20	
98)	BH-10	D-1	D. Spencer	5/20	
99)	BH-10	D-2	D. Spencer	5/20	
100)	BH-10	D-3	D. Spencer	5/20	
101)	BH-10	D-4	D. Spencer	5/20	
102)	BH-10	D-5	D. Spencer	5/20	
103)	BH-10	D-6	D. Spencer	5/20	
104)	BH-10	D-7	D. Spencer	5/20	

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128)	T-1:1	D. Spencer	6/4	1220
129)	T-1:2	D. Spencer	6/4	1225
130)	T-1:3	D. Spencer	6/4	1232
131)	T-1:4	D. Spencer	6/4	
132)	T-1:5	D. Spencer	6/4	
133)	T-1:6	D. Spencer	6/4	
134)	T-1:7	D. Spencer	6/4	1250
135)	T-1:8	D. Spencer	6/4	
136)	T-2:1	D. Spencer	6/4	
137)	T-2:2	D. Spencer	6/4	145
138)	T-3:1	D. Spencer	6/4	250
139)	T-3:2	D. Spencer	6/4	
140)	T-3:3	D. Spencer	6/4	
141)	T-3:4	D. Spencer	6/4	
142)	T-4:1	D. Spencer	6/7	
143)	T-4:2	D. Spencer	6/7	
144)	T-4:3	D. Spencer	6/7	
145)	T-4:4	D. Spencer	6/7	
146)	T-4:5	D. Spencer	6/7	
147)	T-4:6	D. Spencer	6/7	

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LABORATORY NO. 81030-d

Fluorescence Screen, % as benzo(a)pyrene

1	2	3	4	5	6	8	9	10	11
0.005	1.7	2.2	1.3	0.014	1.0	L/0.001	0.004	1.1	0.001
12	13	14	15	16	17	18	19	20	21
L/0.001	L/0.001	L/0.001	L/0.001	L/0.001	0.002	0.93	4.8	L/0.002	0.001
22	23	25	26	27	28	29	30	31	32
0.004	0.009	0.003	L/0.001	L/0.001	0.001	L/0.001	0.004	L/0.001	0.001
33	34	35	36	37	38	39	40	41	42
0.003	0.001	0.003	0.004	0.008	0.002	L/0.001	L/0.001	0.002	0.001
43	44	45	46	47	48	49	50	51	52
L/0.001	0.91	0.081	0.74	0.97	0.88	0.001	0.008	0.007	0.017
53	54	55	56	57	59	60	61	62	63
0.002	0.002	0.003	0.003	L/0.001	0.022	0.007	0.007	L/0.001	0.009
64	65	66	67	68	70	71	72	73	74
L/0.001	L/0.001	L/0.001	0.002	0.056	3.4	0.75	0.041	1.0	0.023
75	77	78	79	80	81	82	83	84	85
0.94	0.002	0.001	0.86	0.054	0.013	0.94	1.2	1.1	1.8
86	87	88	89	90	91	92	93	94	95
1.3	0.042	L/0.001	0.73	1.0	0.90	0.89	0.89	0.006	0.006

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LABORATORY NO 81030-d

Fluorescence Screen, % as benzo(a)pyrene

96	97	98	99	100	101	103	104
1.9	0.71	0.63	0.009	0.002	0.002	L/0.001	L/0.001

128	129	130
0.67	0.73	0.008

131	132	133	134	135	136	137	138	139	140
0.37	1.3	0.002	L/0.001	L/0.001	0.002	0.50	0.32	0.84	1.0

141	142	143	144	145	146	147
1.2	1.9	0.43	0.080	0.28	0.48	1.7

Extractables

parts per million (mg/kg), dry basis

	58	69	102	Blank*
acenaphthene	L/0.05	38.	L/0.05	L/0.05
acenapthylene	L/0.05	L/0.15	L/0.05	L/0.05
anthracene	0.88	96.	L/0.05	L/0.05
benzo(a)anthracene	L/0.05	21.	L/0.05	L/0.05
benzo(b)fluoranthene	2.0	18.	L/1.	L/1.
benzo(k)fluoranthene	**	**	**	**
benzo(g,h,i)perylene	0.68	8.2	L/1.	L/0.5
benzo(a)pyrene	0.34	7.6	L/0.5	L/0.5
2-chloronaphthalene	L/0.05	L/0.15	L/0.05	L/0.05
chrysene	L/0.10	23.	L/0.10	L/0.10

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	parts per million, (mg/kg), dry basis			
	58	69	102	Blank*
dibenzo(a,h)anthracene	0.31	5.6	L/0.10	L/0.10
1,2-dichlorobenzene	L/0.05	L/0.15	L/0.05	L/0.05
1,3-dichlorobenzene	L/0.05	L/0.15	L/0.05	L/0.05
1,4-dichlorobenzene	L/0.05	L/0.15	L/0.05	L/0.05
fluoranthene	2.3	48.	L/0.05	L/0.05
fluorene	0.24	26.	L/0.05	L/0.05
indeno(1,2,3-cd)pyrene	L/0.10	7.5	L/0.10	L/0.10
isophorone	L/0.10	L/0.30	L/0.10	L/0.10
2-methylnaphthalene	0.20	L/0.15	L/0.05	L/0.05
naphthalene	0.69	9.5	L/0.05	L/0.05
phenanthrene	0.84	91.	L/0.05	L/0.05
pyrene	2.5	56.	L/0.10	L/0.10
1,2,4-trichlorobenzene	L/0.05	L/0.15	L/0.05	L/0.05
bis(2-ethylhexyl)phthalate	L/0.05	L/0.15	L/0.05	20.1
butyl benzyl phthalate	L/0.05	L/0.15	L/0.05	L/0.05
di-n-butyl phthalate	L/0.05	L/0.15	L/0.05	L/0.05
diethyl phthalate	L/0.05	L/0.15	L/0.05	L/0.05
dimethyl phthalate	L/0.05	L/0.15	L/0.05	L/0.05
di-n-octyl phthalate	L/0.05	L/0.15	L/0.05	0.087
aniline	L/0.05	L/0.15	L/0.05	L/0.05
benzidine	L/0.2	L/0.6	L/0.2	L/0.2
benzyl alcohol	L/0.05	L/0.15	L/0.05	L/0.05
bis(2-chloroethyl)ether	L/0.05	L/0.15	L/0.05	L/0.05
bis(2-chloroethoxy)methane	L/0.05	L/0.15	L/0.05	L/0.05
bis(2-chloroisopropyl)ether	L/0.05	L/0.15	L/0.05	L/0.05
4-bromophenyl phenyl ether	L/0.05	L/0.15	L/0.05	L/0.05
4-chlorophenyl phenyl ether	L/0.05	L/0.15	L/0.05	L/0.05
4-chloraniline	L/0.05	L/0.15	L/0.05	L/0.05
dibenzofuran	L/0.05	L/0.15	L/0.05	L/0.05
3,3'-dichlorobenzidine	L/0.2	L/0.6	L/0.2	L/0.2
1,2-diphenylhydrazine	L/0.05	L/0.15	L/0.05	L/0.05
hexachlorobenzene	L/0.05	L/0.15	L/0.05	L/0.05
hexachlorobutadiene	L/0.05	L/0.15	L/0.05	L/0.05
hexachlorocyclopentadiene	L/0.05	L/0.15	L/0.05	L/0.05

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parts per million (mg/kg), dry basis

	58	69	102	Blank*
hexachloroethane	L/0.05	L/0.15	L/0.05	L/0.05
2-nitroaniline	L/0.05	L/0.15	L/0.05	L/0.05
3-nitroaniline	L/0.05	L/0.15	L/0.05	L/0.05
4-nitroaniline	L/0.05	L/0.15	L/0.05	L/0.05
nitrobenzene	L/0.05	L/0.15	L/0.05	L/0.05
n-nitroso-diphenylamine	L/0.05	L/0.15	L/0.05	L/0.05
n-nitroso-dipropylamine	L/0.05	L/0.15	L/0.05	L/0.05

Key

L/ indicates "less than"
*A water blank was used and results calculated on a 20 gram dry weight basis.
**Benzo(b)fluoranthene and benzo(k)fluoranthene are reported as one value in the benzo(b)fluoranthene column.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

Mike Nelson

Mike Nelson

cc Don Spencer
The Dalles, OR

MN:bg

APPENDIX D-6

WATER SAMPLE ANALYSIS RESULTS

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CLIENT Woodward Clyde Consultants
c/o Don Spencer
2110 E. 10th Street
The Dalles, OR 97058

LABORATORY NO. 81030-c

DATE July 27, 1983

REPORT ON WATER

SAMPLE IDENTIFICATION Marked as shown below:

TESTS PERFORMED AND RESULTS

148) BH-1:1 D. Spencer 6/8
149) BH-2:2 D. Spencer 6/8

151) BH10
152) BH15
153) BH8

156) BH5
157) BH6
158) BH8A
159) BH2A 6/20/83
160) BH5A 6/20/83
161) BH12 6/20/83
6/21 D. Spencer

167) BH12A

glass electrode at 25°C

	148	149		151	152	153
pH	6.1	6.4		6.4	6.1	6.2
		155	156	157	158	159
pH		6.5	6.3	6.3	6.6	7.3
	160	161				167
pH	7.0	7.8				7.0

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LABORATORY NO 81030-c

micromhos/cm at 25°C

	148	149	156	151	152	153
Specific Conductivity	620.	750.		720.	450.	740.

	156	157	158	159
Specific Conductivity	1000.	360.	950.	510.

	160	161	167
Specific Conductivity	380.	410.	990.

parts per million (mg/L)

	148	149	151	152	153
Total Alkalinity as CaCO3	310.	370.	300.	230.	310.
Sodium	26.	26.	56.	17.	34.
Calcium	60.	90.	42.	44.	45.
Magnesium	30.	30.	25.	22.	22.
Potassium	14.	16.	23.	16.	18.
Chloride	20.	29.	39.	12.	19.
Sulfate as SO4	L/1.	L/1.	L/1.	2.	L/1.
Nitrate + Nitrite	L/0.05	L/0.05	0.08	0.10	0.11
Total Phenol	0.009	L/0.005	---	---	---

	156	157	158	159
Total Alkalinity as CaCO3	370.	160.	480.	270.
Sodium	78.	25.	40.	25.
Calcium	86.	38.	92.	55.
Magnesium	23.	5.4	46.	23.
Potassium	18.	13.	25.	14.
Chloride	93.	17.	31.	14.

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LABORATORY NO. 81030-c

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parts per billion (ug/L)

			156	157	158	159
Benzene			17000.	94.	14000.	L/1.
Toluene			17000.	39.	9200.	L/1.
Xylenes			17000.	150.	4600.	L/1.
Pentachlorophenol			---	---	---	L/10.
Total PNAs as benzo(a) pyrene, corrected for naphthalene	12.2	42.5	4240.	930.	22700.	2640.

	160	161	167
Benzene	980.	L/1.	L/1.
Toluene	640.	L/1.	L/1.
Xylenes	490.	L/1.	L/1.
Pentachlorophenol	---	---	---
Total PNAs as benzo(a) pyrene, corrected for naphthalene	5210.	6.8	745.

Key

L/ indicates "less than"

cc Paul Farenthold
Woodward Clyde Consultants

Respectfully submitted,

Laucks Testing Laboratories, Inc.

Mike Nelson

MN:bg

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LABORATORY NO 81030-c

parts per million (mg/L)

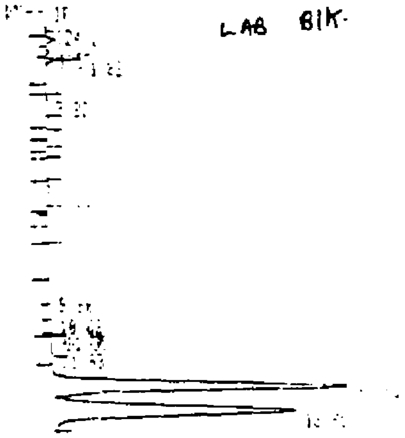
	156	157	158	159
Sulfate as SO4	6.	L/1.	33.	4.
Nitrate + Nitrite	0.09	L/0.05	0.10	0.28
Total Phenol	---	---	---	L/0.005

	160	161	167
Total Alkalinity as CaCO3	340.	220.	500.
Sodium	4.1	28.	24.
Calcium	110.	41.	140.
Magnesium	46.	17.	48.
Potassium	3.6	15.	24.
Chloride	10.	8.	42.
Sulfate as SO4	L/1.	L/1.	L/1.
Nitrate + Nitrite	0.15	0.48	0.36
Total Phenol	---	---	---

parts per billion (ug/L)

	148	149	151	152	153
Benzene	L/1.	L/1.	24.	L/1.	7000.
Toluene	L/1.	L/1.	L/1.	L/1.	4100.
Xylenes	2.1	L/1.	5.0	6.0	5200.
Pentachlorophenol	L/10.	L/10.	---	---	86.
Total PNAs as benzo(a) pyrene, corrected for naphthalene	115.	5.7	12.8	10.4	1839.

SETÄ

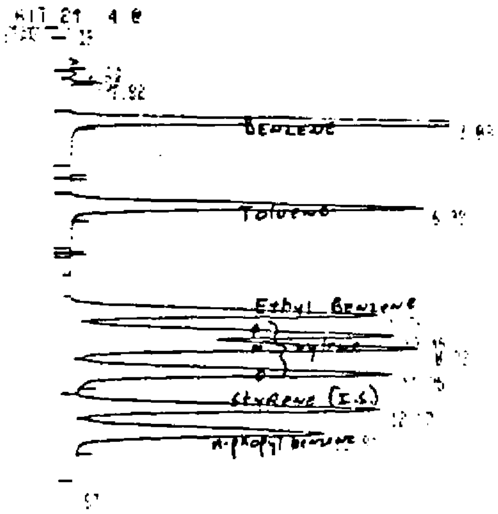


TOP

JN # 90 JUN/17/93 15:15:26

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
0.74	76	PB		0.00?
1.15	240??	BB		?.00?
1.57	10971	BB		?.00?
1.82	7033 D	BB		0.00?
3.22	2651	BB	1R	0.06?
6.38	10219	BB	2R	0.244
9.96	5140	PB	3R	0.14?
10.62	964	BB	4R	0.04?
11.11	2962	BB	5R	0.130
11.35	1306 D	BB		0.00?
11.93	65	PB	6R	0.00?
13.10	1621800	PB	7R	42.00?
13.35	1626400	BB	8R	4?.?4?



RUN # 89 JUN/17/93 15:16:1?

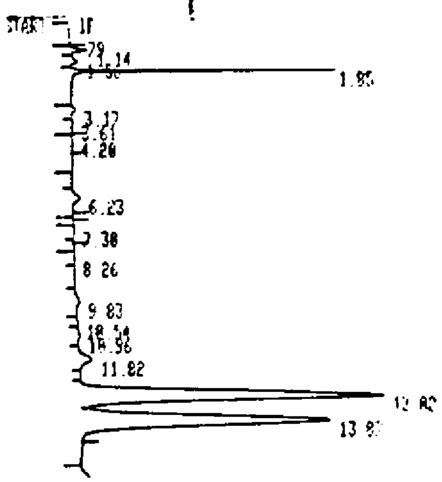
ISTD

RT	AREA	TYPE	CAL#	AMOUNT
1.14	12684	PB		0.000
1.54	14250	BB		0.000
1.82	14330	BB		0.000
3.06	3463700	PB	1R	90
6.86	1839300	PB	2R	41
9.76	1590900	PB	3R	40
10.45	963360	BB	4R	42
10.63	1093100	BB	5R	46
11.75	1870200	BB	6R	44
12.97	1688700	PB	7R	42
13.81	1645800	BB	8R	40

TOTAL AREA= 1.4196E+07
ISTD AMT= 4.2000E+01
MUL FACTOR= 1.0000E+00

TOTAL AREA= 3314500
ISTD AMT= 4.2000E+01
MUL FACTOR= 1.0000E+00

ID 81030-148



STOP

RUN # 91 JUN/17/83 16:07:47
ID 81030-148

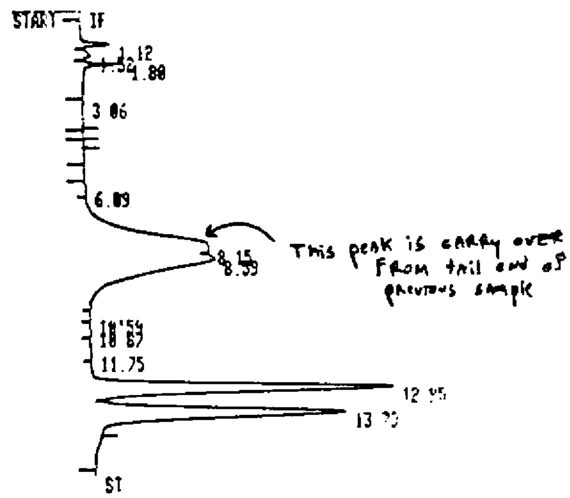
ISTD

RT	AREA	TYPE	CAL#	AMOUNT
0.79	736	PB		0.000
1.14	36632	PB		0.000
1.56	23633	BB		0.000
1.85	93782	D BB		0.000
3.17	14473	BB	1R	0.343
3.61	5941	BB		0.000
4.20	2584	PB		0.000
6.23	36667	PB	2R	0.841
7.38	3621	BB		0.000
8.26	3822	BB		0.000
9.83	21177	PB	3R	0.569
10.54	1881	BB	4R	0.083
10.96	10234	BB	5R	0.430
11.82	66489	BB	6R	1.575
13.02	1689100	PB	7*	42.000
13.87	1678600	BB	8R	40.877

TOTAL AREA= 3689400
ISTD AMT= 4.2000E+01
MUL FACTOR= 1.0000E+00

"A"

ID 81030-149 0



RUN # 92 JUN/17/83 16:31:15
ID 81030-149

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
1.12	47252	PB		0.000
1.52	22838	BB		0.000
1.80	12446	BB		0.000

RUN # 92 JUN/17/83 16:31:15
ID 81030-149

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
1.12	47252	PB		0.000
1.52	22839	BB		0.000
1.80	12446	BB		0.000
3.06	1689	BB	1R	0.042
6.09	6772	PB	2R	0.161
8.15	0	BB		0.000
8.59	0	BB		0.000
10.87	3445	PB	5R	0.150
11.75	2412	BB	6R	0.059
12.95	1629800	BB	7*	42.000
13.79	1658000	BB	8R	41.844

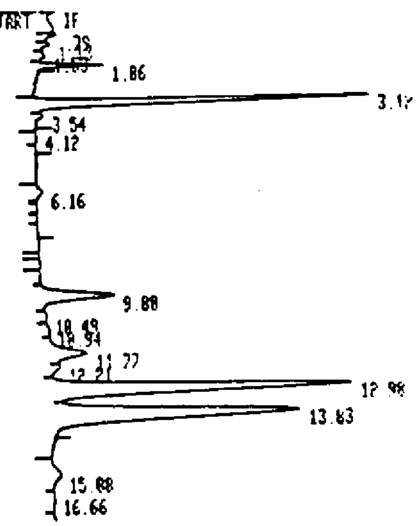
TOTAL AREA= 3384700
ISTD AMT= 4.2000E+01
MUL FACTOR= 1.0000E+00

ID 8 1 0 3 0 - 1 5 1 0

ZERO NOT READY

STOP

"A"



STOP

RUN # 94 JUN/17/83 17:18:10
ID 81030-151

ISTD

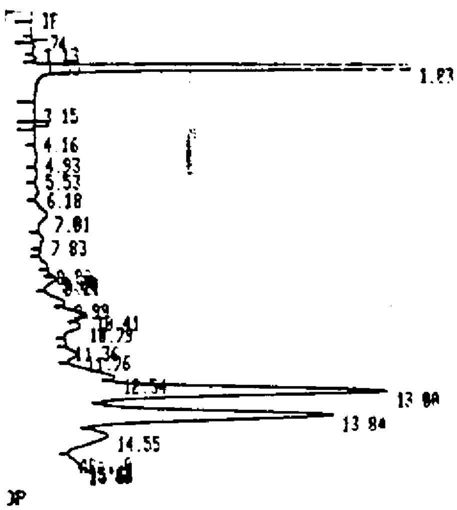
RT	AREA	TYPE	CAL#	AMOUNT
0.79	5161	BB		0.000
1.13	12720	BB		0.000
1.53	14768	BB		0.000
1.86	121270	BB		0.000
3.12	1006100	PB	1R	24.316
3.54	10736	BB		0.000
4.12	2085	BB		0.000
6.16	27944	PB	2R	0.653
9.80	402190	PB	3R	11.004
10.49	6598	BB	4R	0.296
10.94	8933	BB	5R	0.383
11.77	179780	BB	6R	4.339
12.21	13550	BB		0.000
12.98	1657900	BB	7R	42.000
13.83	1650000	BB	8R	40.937
15.88	69896	PB		0.000
16.66	7100	BB		0.000

TOTAL AREA= 5196700
ISTD AMT= 4.2000E+01
MUL FACTOR= 1.0000E+00

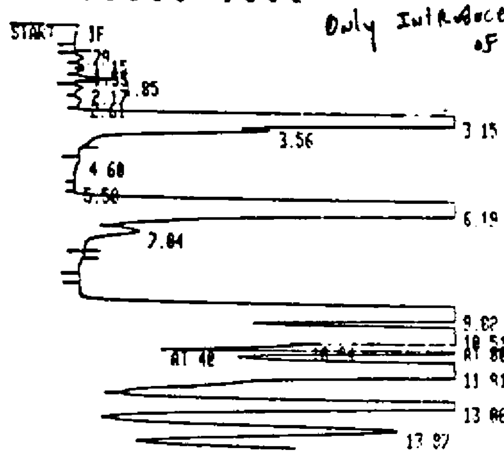
A

multiply All values by 5
Only Introduced 20% of Sample

81030-1520



ID 81030-1530



4 # 95 JUN/17/83 17:42:51
81030-152

TD

RT	AREA	TYPE	CAL#	AMOUNT
0.74	0	PB		0.000
1.13	8385	BB		0.000
1.55	9097	BB		0.000
1.83	5411900	BB		0.000
3.15	4600	PB	1R	0.118
4.16	3394	PB		0.000
4.93	10106	BB		0.000
5.53	8540	BB		0.000
6.18	13777	BB	2R	0.341
7.01	86221	BB		0.000
7.83	17696	BB		0.000
8.82	5698	PB		0.000
9.08	0	BB		0.000
9.18	313	BB		0.000
9.21	14135	BB		0.000
9.99	17905	BB	3R	0.519
0.41	69156	BB	4R	3.200
0.79	30825	BB	5R	1.399
1.36	1002	BB		0.000
1.76	52229	BB	6R	1.336
2.54	48936	BB		0.000
3.00	1564100	BB	7R	42.000
3.84	1563100	BB	8R	41.106
4.55	197570	BB		0.000

TAL AREA= 9139400
ISTD AMT= 4.2000E+01
L FACTOR= 1.0000E+00

RUN # 96 JUN/17/83 18:04:04
ID 81030-153 153

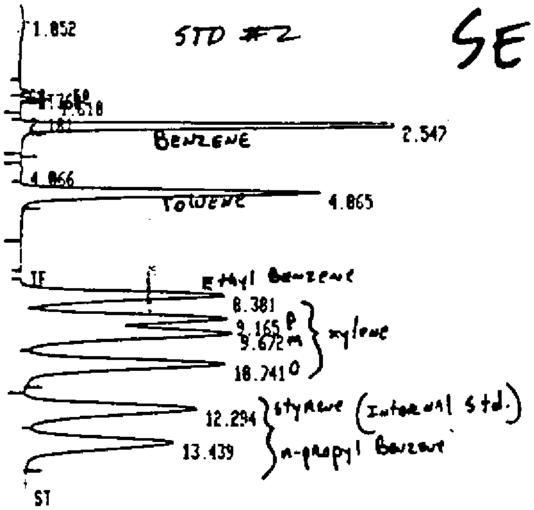
ESTD

RT	AREA	TYPE	CAL#	AMOUNT
0.79	483	PB		0.000
1.15	20505	BB		0.000
1.44	2618	BB		0.000
1.53	2660	BB		0.000
1.85	44967	BB		0.000
2.17	23384	PB		0.000
2.61	22961	BB		0.000
3.15	5.9296E+07	BB	1R	1405.900
3.56	0	BB		0.000
4.60	7694	BB		0.000
5.50	2477	BB		0.000
6.19	3.6109E+07	BB	2R	827.990
7.84	64367	BB		0.000
9.82	2.1597E+07	PB	3R	579.690
10.51	3079400	BB	4R	135.510
10.94	1.4706E+07	BB	5R	617.650
11.81	1.1998E+07	BB	6R	284.040
13.00	3721500	BB	7R	92.408
13.87	1740200	BB	8R	42.353

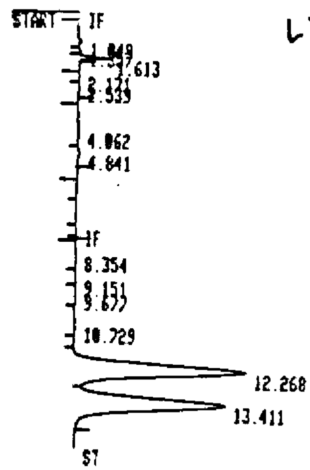
TOTAL AREA= 1.5244E+08
MUL FACTOR= 1.0000E+00

SET "B"

STD #2



LB



RUN # 5

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
0.000	0	PB		0.000
1.052	21244	BB		0.000
1.363	31402	BB		0.000
1.618	136290	BB		0.000
2.181	3136	BB		0.000
2.547	1.0640E+07	BB	1R	161.380
4.066	15068	BB		0.006
4.865	5737100	BB	2R	82.765
8.381	5368400	PH	3R	80.853
9.165	5716700	HH	4R	83.893
9.672	6683300	HH	5R	94.097
10.741	6418800	HH	6R	88.873
12.294	5947600	HH	7L	83.000
13.439	5486200	HH	8R	79.410

TOTAL AREA= 5.2205E+07
ISTD AMT= 8.3000E+01
MUL FACTOR= 1.0000E+00

RUN # 6

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
1.049	20251	PB		0.000
1.357	16763	BB		0.006
1.613	160930	BB		0.000
2.171	3557	BB		0.000
2.539	12535	BB	1R	0.191
4.062	33139	BB		0.000
4.841	40001	BB	2R	0.57[illegible]
8.354	26404	HH	3R	0.398
9.151	27951	HH	4R	0.411
9.677	42398	HH	5R	0.597
10.729	59676	HH	6R	0.827
12.268	5910500	HH	7L	83.000
13.411	5595700	HH	8R	81.811

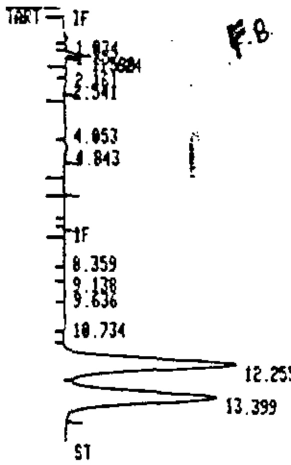
TOTAL AREA= 1.1950E+07
ISTD AMT= 8.3000E+01
MUL FACTOR= 1.0000E+00

RCALB 0
ISTD CALIB RUNS 2
REF % RTW: 3.00 % RTW: 3.00

CAL#	RT	AMT	AMT/AREA
1R	2.51	1.6000E+02	1.5066E-05
2R	4.83	8.2000E+01	1.4329E-05
3R	8.35	8.0000E+01	1.4950E-05
4R	9.13	8.3000E+01	1.4566E-05
5R	9.64	9.3000E+01	1.3967E-05
6R	10.71	8.0000E+01	1.3748E-05
7L	12.26	8.3000E+01	1.3925E-05
8R	13.40	8.0000E+01	1.4498E-05

81030

F.B.



RUN # 7

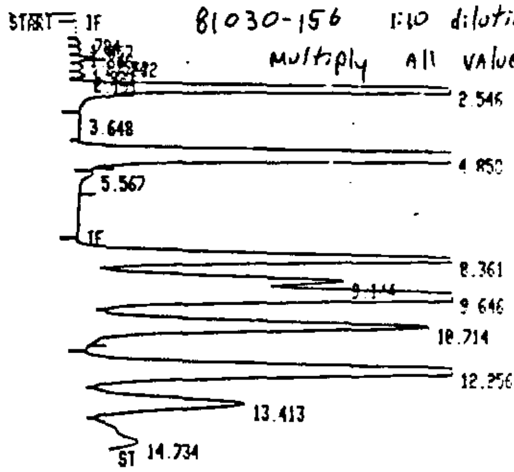
ISTD

RT	AREA	TYPE	CAL#	AMOUNT
1.034	14442	PB		0.000
1.357	16322	BB		0.000
1.590	0	BB		0.000
1.624	0 D	BB		0.000
2.161	12248	BB		0.000
2.541	9779	BB	1R	0.150
4.053	33681	BB		0.000
4.843	45045	BB	2R	0.658
8.359	21102	PH	3R	0.322
9.138	20943	HH	4R	0.311
9.636	33753	HH	5R	0.481
10.734	47160	HH	6R	0.661
12.255	5847000	HH	7R	83.000
13.399	5559100	HH	8R	82.160

TOTAL AREA= 1.1661E+07
ISTD AMT= 8.3000E+01
MUL FACTOR= 1.0000E+00

B

81030-156 1:10 dilution
multiply All values by 10



RUN # 8
ID 81030-156

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
0.784	0	BB		0.000
1.057	30915	BB		0.000
1.348	31099	BB		0.000

ESCAPE

RUN # 8
ID 81030-156

ESTD

RT	AREA	TYPE	CAL#	Actual Values of diluted sample ×320	AMOUNT	×10
0.784	0	BB			0.000	
1.057	30915	BB			0.000	
1.348	31099	BB			0.000	
1.594	0	BB			0.000	
1.632	0 D	BB			0.000	
1.921	42395	BB			0.000	
2.191	56778	BB			0.000	
2.546	3.5283E+07	BB	1R	1699	~~531.580~~	~~16,800~~ 17,000
3.648	39374	BB			0.000	
4.858	3.8079E+07	BB	2R	1747	~~545.620~~	17,000
5.567	0	BB			0.000	
8.361	1.2140E+07	PH	3R	579	~~181.490~~	5,800
9.144	6806000	HH	4R	317	~~99.173~~	3,200
9.646	1.9389E+07	HH	5R	860	~~270.000~~	8,600
10.714	1.1462E+07	HH	6R	502	~~157.590~~	5,000
12.256	1.7335E+07	HH	7R		~~241.400~~	
13.413	6034000	HH	8R		87.482	
14.734	3189200 1	HH			0.000	

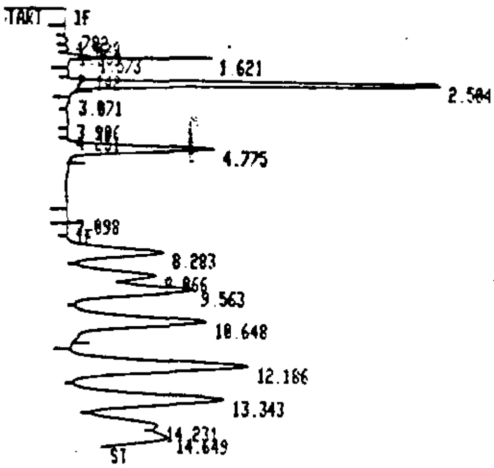
Disregard I.STD.

1.733 / .542 = 320

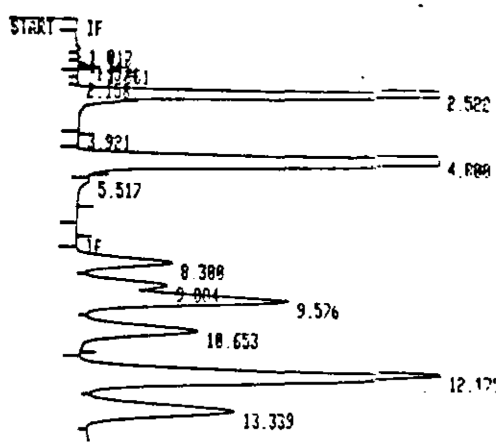
TOTAL AREA= 1.4992E+08
MUL FACTOR= 1.0000E+00

B

ID 81030-157



ID 81030-158 ~~new~~ Dilution 1:25



STOP

RUN # 12
ID 81030-157

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
0.782	0	PB		0.000
1.029	28061	BB		0.000
1.339	27365	BB		0.000
1.573	0	BB		0.000
1.621	214750 D	BB		0.000
2.142	16548	BB		0.000
2.504	6368900	BB	1R	94.440
3.071	7621	BB		0.000
3.906	22325	BB		0.000
4.251	8293	BB		0.000
4.775	2764900	BB	2R	38.992
7.098	1842	PB		0.000
8.283	2586800	VH	3R	38.063
9.066	2395300	HH	4R	34.339
9.563	4006100	HH	5R	55.068
10.648	4671400	HH	6R	63.209
12.186	6855900	HH	7R	83.000
13.343	5438100	HH	8R	77.598
14.231	2915500	HH		0.000
14.649	3562900 I	HH		0.000

TOTAL AREA= 4.1093E+07
ISTD AMT= 8.3000E+01
MUL FACTOR= 1.0000E+00

RUN # 16
ID 81030-158

ESCAPE

RUN # 16
ID 81030-158

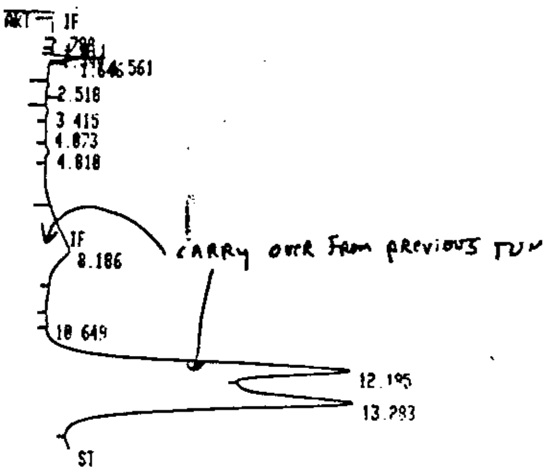
ESTD

RT	AREA	TYPE	CAL#	AMOUNT	
1.017	11802	PB		0.000	
1.343	25442	BB		0.000	
1.574	12014	BB		0.000	
1.661	32609	BB		0.000	x25
2.158	9891	PB		0.000	
2.522	3.5929E+07	BB	1R	541.320	13,533
3.921	133	PB		0.000	
4.880	2.5628E+07	PB	2R	367.220	9,200
5.517	0	BB		0.000	
8.300	2521100	BH	3R	37.692	
9.084	2260300	HH	4R	32.922	825
9.576	6834800	HH	5R	95.453	2390
10.653	3990600	HH	6R	54.864	1370
12.175	1.2896E+07	HH	7R	179.580	
13.339	5811400	HH	8R	84.255	

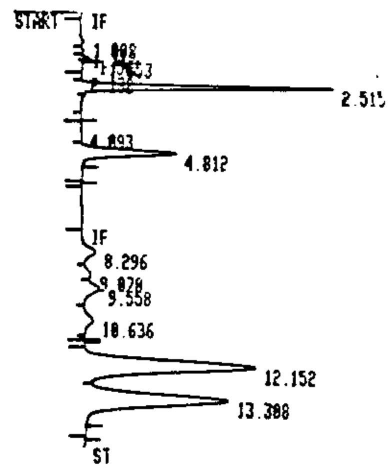
TOTAL AREA= 9.5964E+07
MUL FACTOR= 1.0000E+00

B

ID 81030-1590



ID 81030-1600 1:25 Dilute



JN # 17
) 81030-159

STD

RT	AREA	TYPE	CAL#	AMOUNT
0.780	11578	BB		0.000
1.011	27812	BB		0.000
1.344	15521	BB		0.000
1.561	218910	BB		0.000
1.646	0 D	BB		0.000
2.518	26423	BB	1R	0.398
3.415	31918	BB		0.000
4.073	13288	BB		0.000
4.810	65949	BB	2R	0.945
8.186	1962000	BP	3R	[illegible]
0.649	6638	PP	6R	0.091
2.195	1.4939E+07	PH	7R	208.030
3.283	1.9265E+07	HH	8R	279.300

TAL AREA= 3.6583E+07
L FACTOR= 1.0000E+00

RUN # 18
ID 81030-160

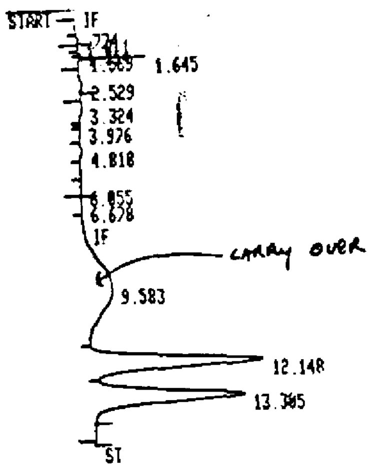
ISTD

RT	AREA	TYPE	CAL#	AMOUNT	
1.008	15698	BB		0.000	
1.342	16431	BB		0.000	
1.562	17710	BB		0.000	
1.653	31866 D	BB		0.000	
2.132	1577	BB		0.000	×25
2.515	2635800	BB	1R	39.286	980
4.093	16509	PB		0.000	
4.812	1811100	BB	2R	25.673	640
8.296	460070	HH	3R	6.804	
9.070	274340	HH	4R	3.953	99
9.558	634050	HH	5R	8.761	220
10.636	505250	HH	6R	6.872	172
12.152	6024800	HH	7R	83.000	
13.308	5567600	HH	8R	79.856	

TOTAL AREA= 1.0013E+07
ISTD AMT= 0.3000E+01
MUL FACTOR= 1.0000E+00

B

ID 8 1 0 3 0 - 1 6 1 0



RUN # 19
ID 81030-161

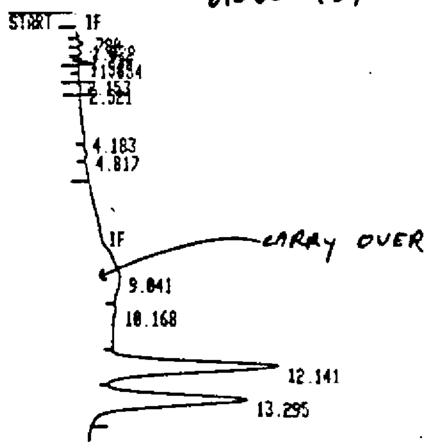
ISTD

RT	AREA	TYPE	CAL#	AMOUNT
0.774	213	PB		0.000
1.011	15839	BB		0.000
1.354	13860	PB		0.000
1.569	6721	BB		0.000
1.645	97710 D	BB		0.000
2.529	33961	PB	1R	0.509
3.324	33260	BB		0.000
3.976	389	BB		0.000
4.818	47331	PB	2R	0.675
6.055	1034	PB		0.000
6.678	2498	PB		0.000
9.583	4303800	BH	5R	59.821
12.148	5989100	HH	7R	83.000
13.305	5754300	HH	8R	83.026

TOTAL AREA= 1.6300E+07
ISTD AMT= 8.3000E+01
MUL FACTOR= 1.0000E+00

B

81030-167



STOP

RUN # 23
ID 81030-164

ISTD

RT	AREA	TYPE	CAL#	AMOUNT
0.780	2983	PB		0.000
1.029	56065	BB		0.000
1.339	33948	BB		0.000
1.567	5714	BB		0.000
1.654	20326 D	BB		0.000
2.153	1556	PB		0.000
2.521	18682	PB	1R	0.234
4.183	0	PB		0.000
4.817	29705	BB	2R	0.354
9.041	5072300	BH	4R	[illegible]
10.168	2685400	HH		0.000
12.141	7169400	HH	7R	83.000
13.295	5768500	HP	8R	69.529

TOTAL AREA= 2.0865E+07
ISTD AMT= 8.3000E+01
MUL FACTOR= 1.0000E+00